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Value for Money

Defining and measuring 'value' in MoD's acquisition policy of obtaining best 'value for money'

PhD Thesis

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ABSTRACT

Obtaining value for money is a keystone of UK Ministry of Defence (MoD) acquisition strategy embedded in its Smart Acquisition policy. This thesis examines how best to measure the relative value of competing tender submissions for major projects.

There is a comprehensive discussion of a wide range of relevant definitions and over three dozen documents are scrutinised including just some sixteen published by the Government. Commercially available models, algorithms and software are examined as well as those used by MoD, concluding that the programs used by MoD are state of the art but that their use could advantageously be mandated for all large programmes. The programs could also be used to combine the wider factors found in each Business Case. This change, used in conjunction with the Combined Operational Effectiveness and Investment Appraisal should improve Investment Approval Board decision quality. An MSc dissertation, supervised as part of this research, looks at how Integrated Project Teams perceive value. An overview of MoD procurement procedures over the last half-century is followed by an appraisal of how MoD measures value for money under the Smart Acquisition regime.

Several recommendations are made outlining how MoD might achieve better, or perhaps more appropriate, value for money when comparing the value of competing bids to select the best one for acquisition. These include avoiding political over-ride of MoD acquisition decisions, firming up aspects of MoD industrial policy, restructuring the Acquisition Management System, stopping acquiring the lowest-cost fully-compliant bid and rejecting offers that exceed the requirement or are unanticipated alternatives. Risk should be considered as a value factor, or the financial cost of various risks calculated. Finally, the phrase 'at lower risk' could beneficially be added to existing aims of Smart Acquisition.

DECLARATION

I confirm that the work presented in this thesis is my own

10 Jan 06

Alex Weiss

ABBREVIATIONS

AHP	Analytic hierarchy process	DG Info	Director General Information
AMS	Acquisition Management System	DG RP	Director General Resource and Plans
ANP	Analytical network process	DG (S&A)	Director General (Scrutiny & Analysis)
AR&M	Availability, reliability & maintainability	DI	Development item
ARP	Applied research project	DLO	Defence Logistics Organisation
ASW	Anti-submarine warfare	DMU	Diminishing marginal utility
BC	Business Case	DPA	Defence Procurement Agency
C^3I	Command, control, communications and intelligence	Dstl	Defence Scientific & Technical Laboratory
CADMID	Concept, Assessment, Demonstration, Manufacture, In-service and Disposal	EP	Equipment plan
CALS	Continuous acquisition lifecycle support	FOC	Full operational capability
CAS	Contract acceptance schedule	FCO	Foreign and Commonwealth Office
CCII	Command, control, information infrastructure	GFE	Government furnished equipment
CCTO	Cost capability trade-off	GFF	Government furnished facilities
CDL	Chief of Defence Logistics	GFI	Government furnished information
CDP	Chief of Defence Procurement	GFR	Government furnished resources
CIRPLS	Computer integration of requirements, procurement, logistics and support	HCI	Human-computer interface
CM(IS)	Capability management (information systems)	HMT	Her Majesty's Treasury
COE	Common operating environment	HR	Human resources
COEIA	Combined operational effectiveness & investment appraisal	IAB	Investment Appraisal Board
COO	Cost of ownership	IBT	Integrated business team
COTS	Commercial off-the-shelf	ILS	Integrated logistic support
CPS	Cardinal points specification	IO	Interoperability
CRP	Corporate research project	IOC	Initial operational capability
CSA	Chief Scientific Advisor	IP	Intellectual property
DA	Design authority	IPR	Intellectual property rights
DASA	Defence Analytical Services Agency	IPT	Integrated project team
DCRS	Directorate Capability Requirements Scrutiny	IPTL	Integrated project team leader
DEAMS	Defence equipment acquisition and materiel support	ISD	In-service date
DEC	Director Equipment Capability	ISO	International Standards Organization
DEFCON	Defence terms and conditions of contract	IT	Information technology
		ITEA	Integrated test evaluation and acceptance

ITEAP	Integrated test evaluation and acceptance plan	PFI	Private finance initiative
ITT	Invitation to tender	PPP	Public private partnership
KR	Key requirement	PQQ	Pre-qualification questionnaire
KSR	Key system requirement	PSC	Public sector comparator
KUR	Key user requirement	PUS	Permanent Under Secretary
LCC	Life cycle cost	R&M	Reliability and maintainability
MACE	Multi(ple)-attribute choice elucidation	RAB	Resource accounting & budgeting
MAUT	Multi-attribute utility theory	RAF	Royal Air Force
MAVT	Multi-attribute value theory	RAMP	Risk analysis and management for projects
MCA	Multi-criteria analysis	RM	Requirements Manager
MCDM	Multi-criteria decision-making	RN	Royal Navy
Mil-Std	Military standard	RP	Research project
MoD	Ministry of Defence	STP	Short-term plan
MOTS	Military off-the-shelf	SW-CMM	Capability maturity model for software
MOU	Memorandum of Understanding	TACS	Tender assessment and contractor selection
MR	Maritime reconnaissance	T & E	Test and evaluation
NAO	National Audit Office	TD	Technical demonstrator
NATO	North Atlantic Treaty Organization	TLB	Top-level budget
NBC	Nuclear, biological and chemical	TLC	Through-life cost
NDI	Non-development item	TLMP	Through-life management plan
OA	Operational analysis	TOPSIS	Technique for order preference by similarity to ideal solution
OCCAR	Organisme Conjoint de Coopération en matière de l'armament	TRL	Technology Readiness Level
OE	Operational effectiveness	TUPE	Transfer of Undertakings (Protection of Employment) Regulations 1981
OGC	Office of Government Commerce	UN	United Nations
OJEU	Official Journal of the European Union	UOVP	Unique organisation value proposition
OTS	Off-the-shelf	URD	User requirement document
PCAE	Pre-contract award evaluation	V&A	Verification and acceptance
PCT	Performance, cost, time	VCDS	Vice Chief of Defence Staff
PD	Project definition	V•I•S•A	Visual interactive sensitivity analysis
PDG	Project development group	VFM	Value for money
PE	Procurement Executive	WLC	Whole-life cost

TABLE OF CONTENTS

TABLE OF FIGURES

FOREWORD

Value is the quality of being useful or desirable and varies between people and with changing circumstances. A nail has little value but in the words of the traditional nursery rhyme: '*The Kingdom was lost ... and all for the sake of a horseshoe nail.*' A more cynical view was taken by Oscar Wilde who said some people '*know the cost of everything and the value of nothing.*'[1] Just over a century ago, John Ruskin observed[2]: "*It is unwise to pay too much, but it is worse to pay too little. When you pay too much, you lose a little money ... that is all. When you pay too little you sometimes lose everything, because the thing you bought was incapable of doing the things it was bought to do.*' This is very similar to the Office of Government Commerce 2003 observation [3]: '*If a Department pays too little, then it may be that what is delivered fails to provide the Department with what it set out to obtain.*'

In considering value for money, NAO stated in 2001[4] that '*The Ministry of Defence still has no means of measuring value for money in multi-million pound projects.*' The MoD Acquisition Management Systems[5] states: '*It is in the interests of both MoD and Industry to overcome the dissatisfaction expressed by Parliament, the taxpayer and Treasury towards cost over-runs and poor Value for Money.*' Finally, Nick Szabo of George Washington University[6] has commented that '*The measurement of value is one of the most intractable problems of civilization.*'

1.1 Acknowledgements

My sincere thanks go to Professor David Kirkpatrick who started me on the road to this undertaking. He provided friendly and supportive advice over the whole period of this research. Also thanks to Professor David Andrews who took over as my formal supervisor for the last year of this project and provided detailed comments on the final draft of this thesis, and to Ian Barrett who provided support in the first few years. Special thanks go to Jane Weiss, who introduced me to the work of actuaries, and to Dave Warriner who carried out a project in the summer of 2004 into how Integrated Project Teams assess best value bids. His work formed his MSc Defence Systems Engineering Dissertation. Thanks also go to the many people in MoD, industry and UCL who have given their time talking to me and providing helpful opinions. Finally I must mention my wife, who has had to live with my almost continuous involvement with this research for the last five years.

This thesis is dedicated to the memory of my mother Eve Powell Weiss, a graduate of Royal Holloway College, who despaired of her un-academic son.

1.2 Author overview

Alex Weiss is a mature student who spent a lifetime in industrial sales and marketing before taking early retirement and joining UCL. His interest in value was first sparked many years ago by government customers' obsession with purchasing the lowest price offering.

1 INTRODUCTION

'A principal objective of all Government spending is to secure value for money for the taxpayer.' [7]

This thesis is submitted in candidacy for a PhD. It considers the issue of how the UK Ministry of Defence (MoD) can obtain best value for money in its source selection procedures. It recognises that, although a complex problem, money can be quantified. However, the measurement of value appears to be much more subjective. Thus, the research concentrates on how to define value and establish a value hierarchy, the attitudes of MoD staff to value and how to measure relative (rather than absolute) value, thus enabling relative value for money also to be measured.

It is perhaps hardest to judge value in major operational equipment purchases – command & control systems, platforms (ships, armoured fighting vehicles and aircraft) and complex weapons such as guided missiles together with through-life equipment support for these items. Thus efforts have concentrated on major projects and examined ways of measuring the comparative value of competitive offerings. Where these equipments are acquired as part of collaborative programmes, the UK approach to such projects has been considered.

Less major procurements, including buildings, civil works, consumables and other relatively inexpensive items are not considered. Furthermore, the value added by the members of the armed forces and civil servants working in MoD is also excluded and new data obtained post source selection is not taken into account, except in the broadest sense where it may help to explain how to select the best source of value.

One area where MoD clearly differs from most other organisations is that it does not get a measurable 'return on investment' in its equipment, apart from in the ability to win wars. Thus the main factors to be considered are performance, timescale and risk as well as the more recently introduced effective integration. In this context, financial risk is considered to be part of money.

A literature search has produced a plethora of documents describing MoD's present procedures for source selection and has also resulted in the following conclusions. First, while much has been written about value and value for money, only a few documents, apart from the Acquisition Management System (AMS), have been found that are of direct relevance to MoD procurements of major operational equipment. Second, MoD recommends the use by Integrated Project Teams (IPTs) of several effective software programs to assist in measuring relative value. Thirdly, the COEIA (combined operational effectiveness and investment appraisal) used to select best value for money solutions divides into two parts: combined operational effectiveness examines military value while the investment appraisal deals with the money side. The combined operational effectiveness does not represent all aspects of value effectively, though the majority of the missing aspects of value (other factors) are included in the associated Business Case.

Thus effort has concentrated on:

1. Discovering how MoD currently carries out source selection and assesses value for money.
2. Establishing definitions of value, a value hierarchy and determining the attitude to value of those MoD staff involved in source selection.
3. Creating value models and deciding the best way to measure relative value.
4. Considering what happens when an IAB (Investment Appraisal Board) recommendation is not accepted.

1.1 UK MoD

MoD has what it calls its Defence Vision[8]. This divides into two parts; first, defending the UK and its interests, and second, strengthening international peace and stability. MoD aims to achieve this by: '*working together on its core task to produce battle-winning ... equipment.*' It also states that this means: '*Working in closer partnership with the private sector to deliver value for money.*' Value for money can only be delivered if MoD can define value and measure the comparative value of competing equipment tenders.

1.2 European Foundation for Quality Management's Excellence Model [9]

The Defence Procurement Agency (DPA), Defence Logistics Organisation (DLO) and Equipment Capability Customer (ECC) have all adopted the European Foundation for Quality Management's Excellence Model, which provides a comprehensive framework for improvement and change by providing the opportunity for continuous monitoring of organisational performance. This model requires that the processes are improved, as needed, using innovation in order fully to satisfy and generate increasing value for customers and other stakeholders. Thus they should be well prepared to embrace the results from this research.

1.3 Utilitarianism

> *'In the late eighteenth and early nineteenth centuries, Jeremy Bentham and others, in developing utilitarianism, proposed that the utility of actions should be measured to determine which actions would produce the greatest good for the most people. Bentham suggested the development of a felicific calculus, a mathematical system that he claimed would allow economists to make such measurements and comparisons ... Following Bentham's suggestions, attempts were made to measure the marginal utility of goods and services.'* [10]

It is hoped that, by following in the footsteps of UCL's most renowned philosopher, it may be possible to improve on the ability to measure comparative value during source selection of major items of military equipment; this value hopefully being for the greatest good for the most people in the Ministry of Defence ... and the British nation.

2 THE RESEARCH

2.1 Research objectives

The research objectives were divided into three distinct parts and work was carried out in parallel on these three objectives:

1. To determine how to define value and ascertain the attitudes to value of MoD staffs in the main organisations, which are involved in source selection.
2. To discover how UK MoD (Equipment Capability, Defence Procurement Agency and Defence Logistic Organisation) carries out source selection and assesses value for money. (It is recognised that the stakeholders in source selection extend well beyond these three groups.)
3. To establish a hierarchy of value, create value and decision-making models, and decide the best way to measure relative value.

The research has concentrated on major purchases of operational equipment by MoD. Some consideration has also been given to information published by foreign sources.

2.1.1 Objectives 1 and 2 – Current practice and attitudes

In order to achieve the first two objectives above, the response to the following ten key questions has been established. The answers to these questions are given in Section 8.

1. How is MoD currently measuring and securing value for money?
2. What are the various sources of value for MoD, including operational value?
3. Who in MoD gets value and what is the significance of the various different roles?
4. What is the relative importance of those who get value?
5. How is it best to deal with individual bias in actually judging value?
6. How does value change with time?
7. What is the value, if any, of getting more than has been requested?
8. Does project capability specification or budget setting impact on value?
9. How is value affected by short-term attitudes?
10. Can lessons be learned from other organisations?

2.1.2 Objective 3 – Hierarchies of value, value and decision-making models and measuring relative value

The second critical part of the research has tried to establish how relative value can be measured at supplier selection. Work has been undertaken to develop suitable models and to measure relative value in ways that are meaningful to MoD. Section 5 has looked at the current models used by MoD and also gives details of different models that may have application when trying to measure the relative value of MoD's acquisitions of operational military equipment. Some are very basic but at the core of defining value. Others are complex and examine topics such as multi-attribute values and multi-criteria decision-making, particularly by groups. Three software programs – Telelogic DOORS® tender

management (proposal evaluation), Commerce Decisions AWARD and SIBET – are recommended for use by staff in IPTs. These have been examined in detail and are compared with other available software, such as V•I•S•A, to establish their relevance to measuring relative value.[a]

2.2 Research procedure

The research work has involved a number of separate activities and these are listed below.

1. Selected books, papers and articles, both from libraries and the Internet, have been read, based on searches using the words 'Military', 'Defence/defense' and 'Value for Money'. They fall into two main categories – those dealing with defence acquisition and those examining the terms value and value for money. While an extensive search of library data bases and the Internet has shown that there is a plethora of books dealing with value, comparatively little has been written about detailed applications of value for money in judging military procurements. Sources included publications by Parliament, MoD and other UK government ministries, the OGC and DASA, the Institute of Actuaries, academia and a few US government and military sources. A cut off date of 1st January 1985 was used since earlier books and articles, with a few notable exceptions, are only useful from a historical viewpoint.

2. An in-depth review of the MoD on-line Acquisition Management System (AMS), the 'bible' for those involved in acquisition, has been carried out. This large set of documents is continually changing to reflect improvements in acquisition policy.

3. Information has been gathered about present practices and attitudes to value from MoD IPTs. The majority of this work was carried out by a supervised MSc student and produced as a dissertation, using questionnaires and personal interviews. This provided some useful statistics and an appreciation of what IPTs actually do and do not do.

4. Two relevant short courses have been attended and a few meetings have been held with selected individuals in MoD.

5. Contact with NAO was established at the beginning of the research to gather views on value. Their Major Projects Reports have been scrutinised to see how well these key projects represent value for money and whether lessons can be learned.

6. A few reports[b] from civil organisations have been reviewed to establish how they judge value for money in their major procurements and to establish whether there is a possible read-across.

7. The information obtained from documents and interviews has been analysed and assessed to obtain a view of how to measure relative value when acquiring future military systems for

[a] These are detailed in Sections 5.2 and 5.3.
[b] These are covered in Section 8.2.

MoD. The assessment of the data gathered from interviews and questionnaires has been based on establishing the acceptability, applicability and potential problems in such measurements.

8. Available value and decision-making models and software programs have been evaluated and have assisted in the development of value hierarchies and models.

2.2.1 Bias

Galileo noted in Il Saggiatore, back in 1619: '*I say that the testimony of many has little more value than that of few, since the number of people who reason well in complicated matters is much smaller than those who reason badly.*' [11] This suggests that a majority view – normal in democracies – may not necessarily give the best result. However, the meritocracy among MoD military staff and civil servants suggests that senior staff may better be able to judge value than junior ones.

One problem is bias in gathering data from people who are interviewed or sent a questionnaire. In particular, the following points are recognised as areas where bias is likely to arise:

1. In selection of the documents to be reviewed and the audience to be questioned.
2. In responses only from people who have the time.
3. Through self-fulfilling prophecies and people saying what they think answers should be.
4. In go-away or mischievous responses.
5. Through bias when interpreting the responses.

Care has been taken to minimise the results of any bias in this research. This has been an ongoing process, and a formal bias review of the plan for the MSc dissertation was undertaken before any data was gathering. It is recognised that any bias review is likely to be both subjective and judgmental.

As mentioned in Section 8.6.2.6, direct access to people in the Defence Council, Defence Management Board and the Top Level Budget holders proved not to be a practical proposition. This does represent a bias in the results of this research though to a degree it is compensated for by the instructions and other information published and disseminated by these individuals.

2.3 Programme of work

Year 1 – 01/02

Complete transfer thesis.

Year 2 – 02/03

It is assumed that the work year starts on 1st April.

1. Continue reading selected, relevant books, articles and papers.
2. Examine selected Internet information for suitable content.
3. Assess available functional models of value.
4. Gather pertinent algorithms and relevant software programs suitable for measuring value.
5. Decide on an initial list of people to be contacted and start contacting them.

6. Produce contacts data and analyse to obtain a conflated view, checking for bias/skew.
7. Produce draft level 1 and 2 headings for thesis and get agreement.

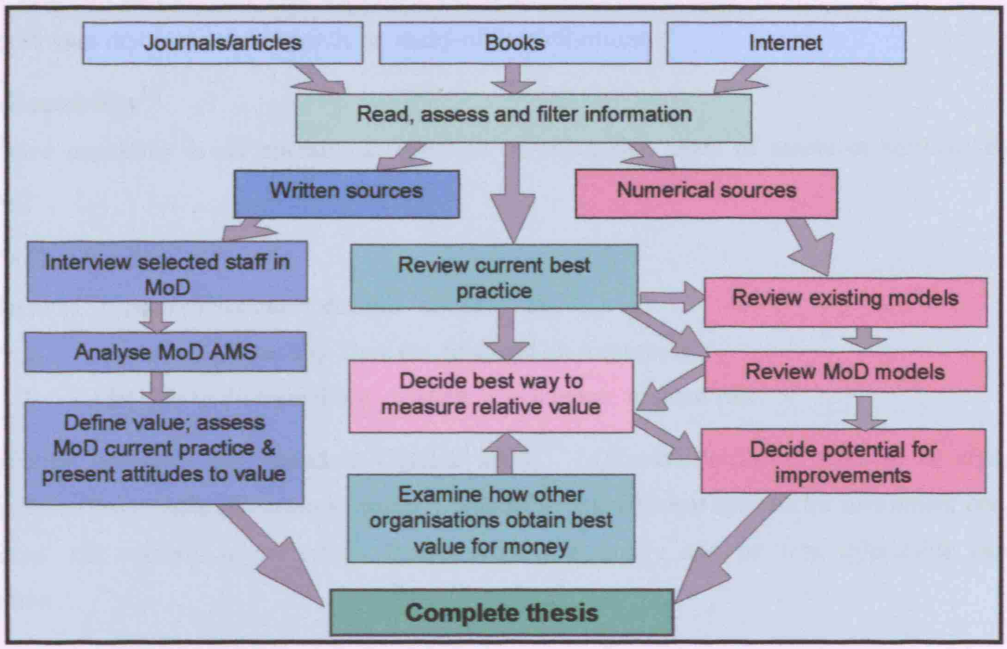

Figure 1 The research has been carried out in a logical manner.

Year 3 – 03/04

1. Review the relevant unclassified parts of MoD AMS. This comprises approaching 1 GB of data!
2. Carry out a bias review to check/improve methodology for obtaining personal views.
3. Complete reading selected books, articles, and papers, and viewing Internet information.
4. Select and analyse material gathered in previous year.
5. Develop definitions of value, a hierarchy of value and functional models of value.
6. Assess available algorithms and accessible software programs for measuring value.
7. Produce draft level 3 headings for thesis. Prepare plan to fill identified gaps in information.
8. Complete first outline of thesis.

Year 4 – 04/05

1. Identify changes in the environment since start of project and their implications.
2. Identify and undertake further reading and individual contacts to update to a second draft.
3. Supervise MSc student research into 'How IPTs assess best value bids.'
4. Improve initial models for measuring value.
5. Produce draft analysis and conclusions of research and complete second draft of thesis.

Year 5 – 05/06

1. Finalise value hierarchies and models.
2. Confirm/amend analysis and conclusions of research.
3. Complete final re-write and submit thesis.

3 DISCUSSION OF DEFINITIONS AND EXCLUSIONS

Rather than just define terms that are considered important to this research, this chapter examines and where relevant discusses and expands on many of the definitions.

3.1 Capability[12]

A defence capability is an operational outcome or effect that users of assets or services need to achieve.

3.2 Affordability

Chambers 21st Century Dictionary defines 'afford' [13] as:

a. To have enough money, time etc. to spend on something.
b. To be able to do something, or allow it to happen, without risk.

UCL Policy Research Unit stated in October 2003: [14] *'Affordability issues need to be rigorously distinguished from 'value for money' issues ... Indeed where different options for investment are being compared, the scheme which shows better value for money can be less affordable than the alternative.'*

The classic meaning of affordability is having enough money to spend on something. This immediately raises a number of issues. First, is the initial procurement price affordable now (with major MoD acquisitions this will have to be included in the STP and EP)? Second, are the life cycle costs affordable (over a life which may exceed half a century and may incur unquantifiably high disposal costs)? Furthermore, the cost of any major project is subject to a degree of uncertainty. Cost over runs (and under spends) can alter the affordability of a project during its life cycle, as can changes to MoD's equipment budget for other reasons.

Then there is the second point made in the dictionary definition – 'enough time?' This may be related to delivery time, but it is more apposite to relate it to management time. So, it might be argued: 'Can we afford the time to go collaborative on this programme, knowing that it will require a major investment of time by senior managers (and ministers) as well as delaying the in-service date?'

There is another issue surrounding time; affordability is time related. The statement 'We cannot afford it now, but we can next year' is not uncommon. Acquisition budgets (and capability statements) are regularly juggled ensure that all the required procurements can be afforded and major project manufacture divided into tranches.[c] The result of this is likely to set ceiling prices on individual projects, which may or may not represent best value for money. Perhaps worse, they may result in 'quick fix' solutions that certainly do not represent best value for money! In addition, trade-offs between project budgets may occur at annual budget reviews.

[c] The impact of dividing manufacture into several tranches is discussed in Section 4.2.1.

Providing a satisfactory value for money case can be made, MoD can justify acquiring anything it needs; its problem is that it cannot afford everything. This suggests that rather than seeking best value for money, it would be better to seek the most appropriate value for money.

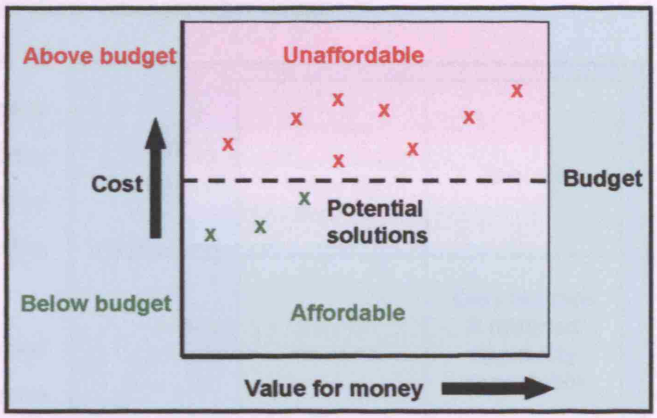

Figure 2 It is possible to plot value for money against affordability.

With the alignment of the IAB scrutiny and approvals processes with Resource Accounting and Budgeting[15], affordability is presented in Business Cases, separately identifying capital and resource implications. The two distinct elements to an affordability assessment are:

1. A demonstration that the resources needed to acquire the asset/service can be contained within existing (and anticipated) resource control totals.
2. An assessment of the longer-term financial consequences of owning, operating and supporting the new equipment once it enters service.

As budgets are set in resource terms, project affordability is established in resource terms, and Business Cases include the expected cost against the likely annual budgetary provision for the life of the project. An assessment of through-life affordability involves comparing cost of ownership statements, including savings from equipment or infrastructure being replaced.

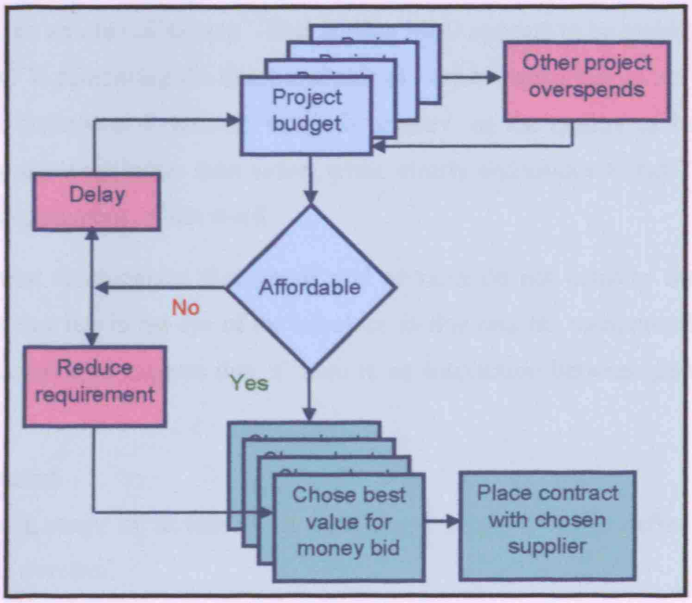

Figure 3 How budgeting and affordability fit in with acquiring best value for money solutions.

Business Cases submitted to the IAB[16] must show, amongst other things:

1. How, given the alternative ways of meeting the requirement and the scope for trade-offs, the optimised military capability or business benefits can be delivered in a way that offers best value for money through life.
2. How the investment will be afforded within existing and foreseeable future budget provision, taking account of the cost of ownership.

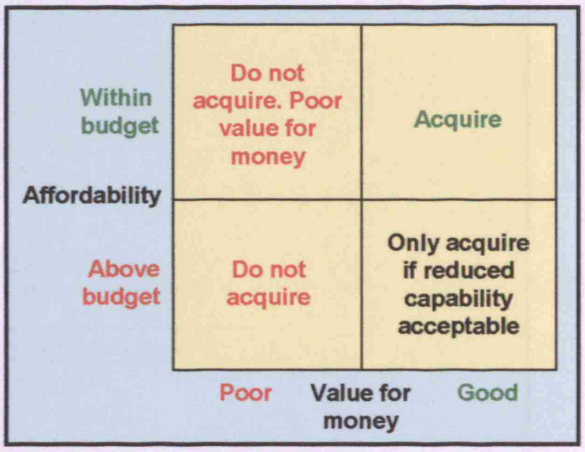

Figure 4 The inter-relationship between affordability, value for money acquisition decisions.

3.3 Value

Chambers 21st Century Dictionary[17] defines value as: *noun* 1. 'worth in monetary terms.' 2. 'the quality of being useful or desirable; the degree of usefulness or desirability.' 3. 'the exact amount of a variable quantity in a particular case.' 4. 'the quality of being a fair exchange □ value for money.' 5. '(values) moral principles or standards.' 6. '*maths* a quantity represented by a symbol or set of symbols.' 7. '*music* the duration of a note or rest.'

Definition 1 is hardly helpful, as 'value for money' becomes 'monetary worth for money'! However, value as worth in monetary terms is in such common usage that care has been taken to avoid this definition in this research. Definition 2 represents the words being sought, for it is the 'degree of usefulness for a given amount of money.' That is what MoD appears to be seeking. Definition 3 is also helpful in that MoD is comparing the exact amounts of variable quantities in several cases to discover which is the best. Definition 4 defines 'value for money' as the quality of being a fair exchange. Definition 5 looks at values rather than value, while clearly definitions 6 and 7 in the dictionary are not relevant to this application of the word.

It is also important to recognise that goods and services do not actually themselves have value. Value is a property that lies in the eye of the beholder, in this case the team members evaluating bids.[18] It is therefore reasonable to suggest that if there is no interaction between people and objects, then there is no value.

3.3.1 Defining value

For MoD, there is a range of factors to be considered when trying to define value and these are detailed in Figure 5 overleaf.

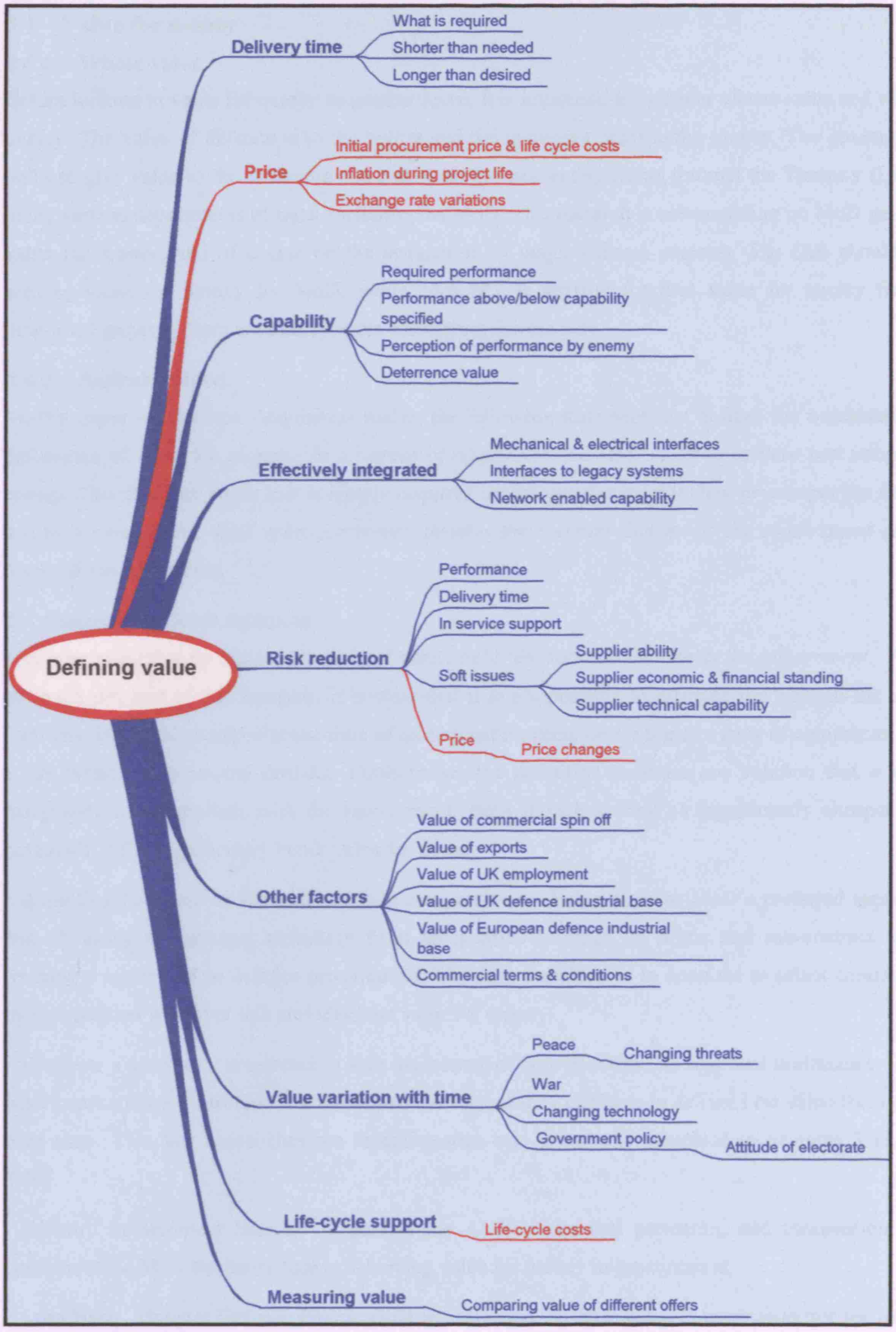

Figure 5 Factors involved in trying to define the value of bids. The items in red are money factors and are not further considered.

3.4 Value for money

3.4.1 Whose value

Before looking at value for money in greater detail, it is important to consider whose value and whose money. The value of defence is to the nation and the taxpayers provide the money. The government seeks to give value to the electorate and partitions government spending through the Treasury (HMT) to the various departments of state, including the MoD. This research is concentrating on MoD gaining value for money, and of course on the acquisition of major defence projects. The IAB should be, seeking value for money for MoD, while each IPT is striving for best value for money for its individual project. There are clearly some conflicting drivers here.

3.4.2 MoD definition

MoD's paper on Defence Acquisition makes the following statement that defines the organisation's definitions of value for money. '*In all areas of acquisition the MoD seeks to achieve best value for money. This does not mean that it simply acquires the cheapest available item or accepts the lowest bid in a competition. Best value for money denotes the solution that meets the requirement at the lowest through-life cost.*'[19]

1 Comment on MoD definition

It is interesting that no mention is made of value, only '*the solution that meets the requirement.*' Also, although not part of this research, it is clear that it is not possible to estimate the through-life costs with any degree of accuracy at the time of an acquisition decision for a major item of equipment with a life measured in several decades. Furthermore, the definition excludes any solution that is even marginally non-compliant with the requirement, even though it may be significantly cheaper and potentially offer significantly better value for money.

Awarding contracts on the basis of open competitive tendering remains MoD's preferred approach and obtaining the greatest advantage from competitive leverage, at prime and sub-contract level, remains a major tool in defence procurement. The aim, therefore, is to continue to select contractors by competition wherever this provides best value for money.

However a contractor is selected, it is in the interest of both MoD and its suppliers to structure – and, where appropriate, restructure – contracts to ensure that they continue to deliver best value for money over time. Two key approaches are incentivisation and gainshare (described in Sections 3.49 and 3.50).

Industry Involvement Basics,[20] a part of the AMS, states that partnering and competition will continue to be MoD's primary tool in achieving value for money in procurement.

Lord Bach, Minister Defence Procurement in 2004 said:[21] '*Best value is more than just the lowest price, best value includes what will bring the best service at the price we can afford for the British armed services.*'

Sir Peter Spencer, Chief of Defence Procurement has stated that in many cases the whole concept of value for money is itself a value judgment, so it is possible to draw different conclusions from the same set of data depending upon people's position and what they are trying to achieve.[22]

An interesting note from an MoD report[23] states under the heading 'Measuring value for money': '*Each main management area has its own system for monitoring and measuring performance. Although from a central MoD perspective these systems meet individual budget holder requirements, they are generally not mutually compatible or presented in a format that allows value for money to be assessed across MoD. The study is therefore unable to conclude that the current provision gives best value; indeed, there is every indication that it does not.*'

Despite DPA and other buyers trying to obtain best value for money, and even though suppliers try to offer best value for money, it is apparent that buyers are inclined to try and negotiate down the price of any offering, while suppliers attempt to offer better value without reducing their price. Figure 6 shows these different aims and the classic non-linear connection between value and money. In an ideal world, both parties should aim to increase value for money.

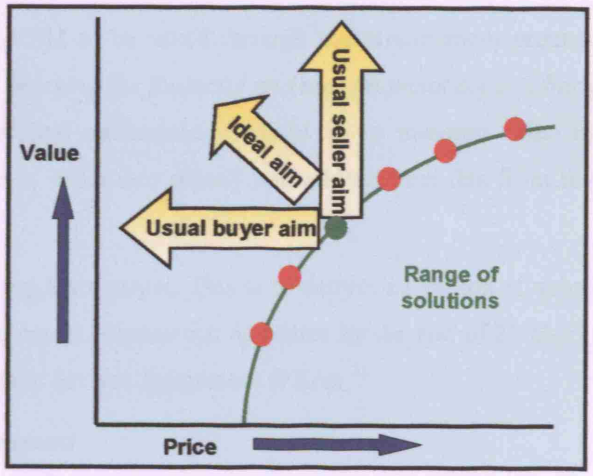

Figure 6 The conflicting aims of buyers and suppliers.

3.4.3 National Audit Office (NAO) definition [24]

NAO states that there are three aspects to value for money:

1. Economy – minimising the cost of resources used or acquired – spending less.
2. Efficiency – the relationship between the output from goods or services and the resources used to produce them – spending well.
3. Effectiveness – the relationship between the intended and actual results of public spending – spending wisely.

NAO's Director, Defence Acquisition Studies defines [25] value for money as '*the economic resource required to generate and sustain a required capability.*'

1 Comment on NAO definition

This definition seems to be a long way off target. First, it makes no mention of timescale. Second it does not consider any of the wider factors that MoD takes into account. The same source suggests that while traditionally MoD has purchased '*the cheapest solution consistent with quality requirements,*' in

future value for money could embrace '*all aspects of capability; worth – balancing affordability, effectiveness and the risk of not taking action across all desired capabilities; and longer term health of the supplier base.*' These comments support the view that MoD is still purchasing the cheapest compliant solution. The observation about embracing all aspects of capability is certainly important, but still misses out many other factors.

3.4.4 Office of Government Commerce definition

Value for Money Evaluation in Complex Procurements – Best Practice [26] provides the following definition of Value for money (VFM) '*the optimum combination of whole-life cost and quality (or fitness for purpose) to meet the user's requirement.*' It also states that this is rarely synonymous with lowest price.

It further lists a number of key questions on VFM to be asked through the procurement process including: '*Have we agreed the methodology for bringing the financial and non-financial aspects back together prior to award decision?*' It says the ideal methodology would be to measure value in financial terms, and then convert any difference in value into money and add/subtract this from the competing suppliers' prices.

Each of the Key Strategies supports the OGC top level target. This is to deliver £1 billion of value for money improvements from central civil government commercial activities by the end of 2002-03. This forms one of the targets in the Treasury's Public Service Agreement (PSA). [27]

1 Office of Government Commerce (OGC) comment

The first paragraph seems to be a weak definition. '*Quality to meet the user's requirement*' looks like capability. What happens about delivery timescale, risk and a host of other factors? Unfortunately, the second paragraph suggests a lack of understanding of value for money. It is reasonable to pursue £1 billion of financial savings – the money side of the equation – and it is also reasonable that if value remains constant and money expended reduces, value for money increases. However, reducing the money side of the equation alone certainly does not ensure best value for money.

3.4.5 Award – EC (European Community) Rules

Amongst other award principles mentioned in the EC Rules, the following are relevant to achieving best value for money.

- The set of award criteria will be a combination of both financial and non-financial factors. The financial criteria will cover the whole-life costs of the contract. Key non-financial criteria will usually include areas of deliverability, service quality, innovation, organisational culture, environmental issues, risk management and partnering/team working.
- To promote price realism and solution deliverability, the recommended approach to value for money evaluation is to differentiate the financial and non-financial criteria for consideration in

separate strands. Attempts to balance these criteria during the process should be avoided. Via a methodology agreed by the Tender Board the two strands should be brought back together prior to the award decision. Procurement professionals within the department should be involved in this process. Unless the best quality bid is also the lowest price bid, the Tender Board must come to a judgement balancing the business risks.

- The mix of criteria and any weighting applied to each individual criterion will depend on the nature of the specific procurement, the business requirement and its context within the operations and strategy of the department. The criteria chosen must support the value for money definition and should not relate to other objectives extraneous to the specific procurement.
- Have we agreed the methodology for bringing the financial and non-financial aspects back together prior to award decision?

1 Comment on Award – EC Rules

The suggested division of factors into financial and non-financial is clearly normal practice in MoD, demonstrated in the COEIA and Business Case submitted to the IAB. The rules imply that the IAB, rather than the IPT should come to a judgement balancing the business risks if the best quality bid is not also the lowest price. The rules also state that the criteria chosen must support the value for money definition and should not relate to other objectives extraneous to the specific procurement. This conflicts with political decisions based, for example, on national or regional employment needs.

3.4.6 Factors affecting value for money

NAO lists a number of factors that affect value for money.[28] Those in the left-hand column are largely money issues and are not considered further, while those in the right-hand column impact on value.

• Inflation • Exchange rate • Receipts • Accounting adjustments & redefinitions • Changed budgetary priorities	• Changes in procurement strategy • Changed requirements • Changes in associated projects • Technical factors • Contracting process • Risk differential

Alterations to the procurement strategy can have a significant impact on the offerings from suppliers; a straight procurement may result in an equipment contract while the outcome of a PFI acquisition will be both the equipment and services needed over a number of years. Changed requirements will alter the desired capability. Changes in associated projects are likely to impact on effective integration and may also affect the budget available for the project. Technical factors are most likely to have a bearing on performance (better) but may have a negative effect on both effective integration and project cost. The contracting process will be important both in terms of the type of contract used (e.g. PFI or a normal procurement) as well as the terms and conditions of contract. Risk

differential is both difficult to quantify and may affect performance, cost, time and effective integration. **Comment**: Why is delivery timescale missing?

3.5 Value engineering and value added

The Larousse Dictionary of Science and Technology [29] states that *'value engineering is a total approach to engineering design that seeks to achieve the required performance, reliability and quality at minimum cost by attention to simplicity, avoidance of unnecessary functions and integration of design and manufacturing techniques.'* This does suggest that the 'required performance, reliability and quality' are all that are desired – nothing else is required! This is fine in a perfect world, but where complex platforms, systems and products are being procured, there is significant difficulty in defining these parameters. However, the clear aim of value engineering is to produce better value for money.

Value added is a term widely used by industrial companies to indicate the work done by its employees on purchased items to convert them into finished products or systems. It is usually quoted in monetary terms. Value engineering and value added are not considered further.

3.6 Expected value [30]

A way of providing a measure of the financial value or cost to be placed on different risks is by multiplying the likelihood by the impact to give the expected value. Thus a 5% likelihood of having an overspend of £1,000,000 would have an expected value of £50,000. Expected value is considered more fully in Section 5.1.3.

3.7 Benefits

Chambers 21st Century Dictionary [31] defines benefit as: *noun* 1. Something good gained or received. 2. Advantage or sake.

3.7.1 Benefits and value

Benefits provide value; a view widely held by suppliers in industry. Thus, to an extent, 'best value' will come from examining the benefits offered by each solution. Whilst, at first sight, all offerings that provide a particular capability level might appear to propound the same benefits, soft issues, commercial terms and conditions, and the degree of risk involved might well vary significantly.

Where there is a specification, it is possible to measure [d] benefits at the lowest possible level of a breakdown structure and conclude that 'Benefits constitute the value to the buyer of what is being acquired.'

3.8 Risk and uncertainty [32]

'There are risks and costs to a programme of action but they are far less than the long range risks and costs of comfortable inaction.' John. F. Kennedy

[d] by assigning a mark out of say 100.

Risk is the possibility of more than one outcome occurring. Government uses the term catastrophic risk where there is a chance of an event happening, which would impose extraordinarily large costs.

A distinction is sometimes made in financial literature between risk and uncertainty, 'risk' being used where probabilities can be precisely estimated and 'uncertainty' where they cannot. In practice any decision-making is based on at least implicit judgements about probabilities. However in some cases probabilities are estimated explicitly and used in formal, quantitative risk analysis, while in others probabilities are not precisely stated. The latter are more common in practice.

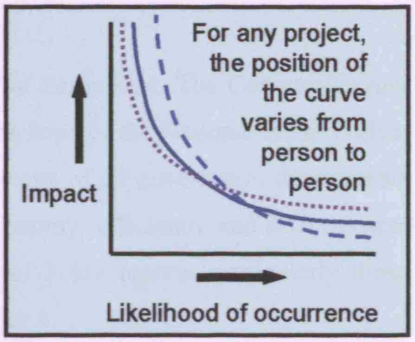

Figure 7 The position of the likelihood of occurrence against impact curve varies depending on an individual's estimate of both factors.

In the acquisition of new equipment, risk will occur in obtaining the required capability, integrating it satisfactorily, obtaining it on time, obtaining it for the price and under the contract terms and conditions required and obtaining through-life support. There is also a risk that the threat will change sufficiently between concept and the in-service date that the capability is no longer needed or changes to the capability required may be essential.

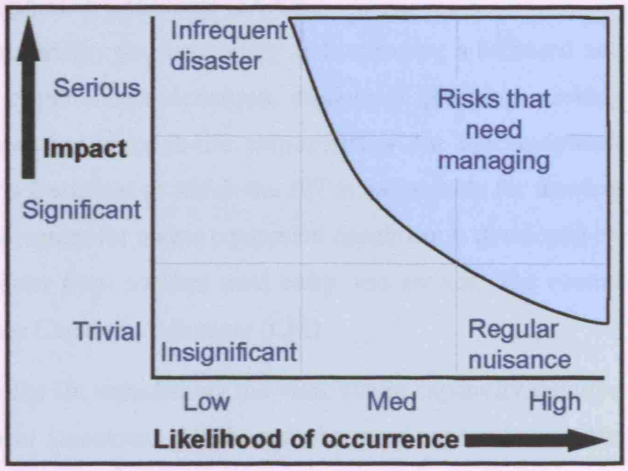

Figure 8 It is essential that risks are managed according to their probability of occurrence and their potential impact.

Risk can be defined as a threat (or opportunity) that could adversely (or favourably) affect achievement of the objectives of an investment.[33] It should also be noted that perceived risk is a human estimate and differs from real risk; the true risk that currently exists.

Actuaries describe a number of different meanings of risk:[34]

1. A synonym for hazard, danger or threat, i.e. an undesirable event.
2. The likelihood of an event occurring.
3. The loss, injury or other outcome resulting from an event.
4. The generality of volatility and uncertainty – the combined effect of all individual risks in an investment or situation, i.e. the overall riskiness.

Mention is also made of the fact that risks can have favourable as well as unfavourable outcomes.

3.9 Military

The word military is used in this document to include the UK Ministry of Defence, Dstl [e] and the armed forces, regardless of whether individuals are uniformed or civil servants.

3.10 National Audit Office (NAO) [35]

The National Audit Office scrutinises public spending on behalf of Parliament. The Comptroller and Auditor General is an Officer of the House of Commons. He is the head of the National Audit Office, which is totally independent of government. He certifies the accounts of all government departments and he has statutory authority to report to Parliament on the economy, efficiency and effectiveness with which departments have used their resources. A number of NAO reports, particularly those related to defence, have been examined; details are given in Chapter 4.

3.11 Customer

There are two different customers within MoD:

3.11.1 Central Customer or Equipment Capability Customer (ECC)

The Equipment Capability Customer has responsibility for developing and managing a balanced and affordable equipment programme including requirements definition, equipment planning, seeking approvals, and authorising acceptance. It also has through-life responsibility for the equipment capability. The ECC within MoD is the Central Customer to which the IPT is answerable for meeting agreed cost and performance targets. The requirement for a new equipment capability is developed by the Central Customer; the customer for a project from concept until entry into service. The central point of contact with the Central Customer is the Capability Manager (CM).

The Central Customer has overall responsibility for establishing the basic future capability required and for setting this out in the User Requirement Document (URD) and obtaining approval (with the IPT Leader) for the project at Initial and Main Gate.

Capability Managers are responsible for identifying the necessary time, cost and performance trade-offs between projects within their capability. The Capability Manager will oversee the IPTs performance against approved performance, time and cost parameters.

3.11.2 Second Customer

The Second Customer is responsible for in-service aspects of the programme, normally part of the organisation of an appropriate front-line Commander-in-Chief, who will make a Customer/Supplier Agreement for the in-service phase specifying the outputs required.

The Second Customer will specify the level of equipment support required from the supplier, through setting agreed targets on performance indicators such as in-service support costs, availability,

[e] The Defence scientific and technical laboratory is a part of the Ministry of Defence.

activity and sustainability at the front line. The Second Customer will also oversee some upgrades to in-service equipment such as improving maintainability or sustainability.

3.12 Customer/Supplier Agreements [36]

A Customer/Supplier Agreement (Acquisition) is a record of agreement between a Director Equipment Capability (DEC), an IPT leader (IPTL), and where appropriate a Second Customer, acting as partners in a military equipment project. It is used to govern the relationship between partners and the progress of the project, and against which business performance is measured.

3.13 Customer and supplier responsibilities

Customer/supplier relationships between the appropriate customer and the IPT are central to Smart Acquisition. A Customer/Supplier Agreement governs each relationship and documents three primary areas:

- The roles and responsibilities of the customer and the supplier.
- The approved Performance-Cost-Timescale (PCT)[f] envelope.
- The PCT targets agreed by the customer and the IPTL.

Customer/Supplier Agreements should be specific to each project and to each phase of the project and should reflect the following division of responsibilities:

3.13.1 Before ISD (in-service date – during the initial procurement phases)

The DEC will have lead responsibility for:

- Providing the User Requirement Document (URD).
- Securing Initial and Main Gate Approvals.
- Agreeing the Integrated Test, Evaluation and Acceptance Plan (ITEAP) with the IPTL and other relevant stakeholders.
- Agreeing with the IPTL the PCT boundaries, including those to be put to the Approving Authorities.

The Second Customer has lead responsibility for developing and specifying levels of availability and sustainability required in service.

The IPT has lead responsibility for:

- Developing the Systems Requirement Document (SRD).
- Consulting the DEC on PCT achievement and trade-offs between them.

The DEC and IPTL have joint responsibility for preparing the Business Case for Main Gate approval.

[f] It is perhaps surprising that EI (effective integration) has not been added to PCT (as of August 2005).

3.13.2 Customer and supplier responsibilities during the manufacture phase

For the customer, the DEC will make key decisions on the future direction of the project including decisions on performance, cost, time parameters, and trade-offs within and between projects. For the supplier, the IPTL will select the contractor(s) for manufacture and negotiate relevant contracts. **Comment**: Thus it is the IPTL who is central to the assessment of the relative value for money of each bid.

3.14 Defence Procurement Agency (DPA) [37]

DPA is an agency of MoD that primarily procures new equipment (or equipment services) for the armed forces.

3.15 Defence Logistics Organisation (DLO) [38]

DLO is an organisation of MoD that primarily provides joint logistics support to the armed forces. The mission of DLO is to '*deliver logistics for operations.*' This has to be done on a tri-service basis for the armed forces.

3.16 Integrated Project Team (IPT)

An IPT is a team that includes the core skills necessary to manage a project through its acquisition cycle. It is the body responsible for managing a project from Concept to Disposal. Its main tasks include translating the Central Customer's statement of required capability into a system definition (the SRD), devising equipment solutions to meet that requirement, producing the material required to support the Customer's Main Gate approval, and managing the procurement and in-service support of the equipment. The Smart Acquisition IPT is characterised by its 'cradle to grave' responsibility, its inclusion of all the skills necessary to manage its project and its effective and empowered leader.

While carrying out these functions, the IPT will be under the line management of either DPA or DLO. The IPT will have to keep carefully in mind the requirements of both. The IPT will be answerable to the lead customer, through a Customer/Supplier Agreement, for the procurement and support of equipment to provide a given capability. In August 2005, MoD listed a total of 191 IPTs. [39]

In summary, each IPT:

- Is responsible for managing its project from concept to disposal.
- Includes all the skills necessary to manage the project.
- Is headed by an effective and empowered IPT leader able to make cost-effective trade-offs between performance, whole-life cost, effective integration and time.
- Has membership representing the key functional interests in equipment acquisition across MoD.

3.17 IPT leader (IPTL)

The IPT leader is the person with overall responsibility for the IPT and the line manager of all its core members. The IPTL may have an extensive background in any one or more of the core IPT membership areas and, if chosen from within MoD, will be a suitably qualified member of the

Acquisition Stream. To succeed, an IPTL will need to have strong leadership and management skills and the desire to achieve results beyond what is currently accepted as the 'norm.'

3.18 Stakeholders [40]

Those people who have an interest in a system are termed stakeholders; the term includes operational stakeholders (users) and system development and support stakeholders. There is a more detailed examination of stakeholders in Section 8.6.2.

3.18.1 User [41]

Users are those people who sit outside the system boundary and benefit from its operation. It does not include individual operators internal to the system. A user is anyone who will actually interact with the system during its operational life. Users are normally equipment operators in the front-line commands.

3.18.2 Supporters

Supporters are the people responsible for maintaining and supporting equipment. They are found in the Defence Logistics Organisation (DLO) or in parts of the front-line commands.

3.19 Requirements [42]

A requirement is an expression of need, demand or obligation. A functional requirement asks for a specific system action or response – 'what the system shall do.' A non-functional requirement does not add additional capability but states the quality characteristics required of the system e.g. reliability, maintainability, safety or standards. A performance requirement states 'how well a function is to be achieved' e.g. response time or speed.

MoD's ECC has a policy that requirements should describe capability, not equipment. It highlights the following unacceptable 'Solutioneering' [43] behaviour factors:

- Replacing legacy platforms like with like.
- Political and industrial imperatives.
- Single-service aspirations.
- Lack of cross DEC vision.
- Solution is obvious.
- Easier to protect hardware from budgetary pressure.
- Low ARP pull though/minimal industry funded research.
- Traditional competition stifling innovation.
- Embryonic capability thinking outside ECC.
- Need to move projects forward rather than stagnate in never-ending Concept Phases.
- Thinking platforms, not capability.
- Too high a hurdle at Initial Gate.
- IPTs too solution focussed early on.
- Overbearing requirements of OA justification.
- Need to bound Assessment Phase more clearly so as not to waste funds.
- For IPTs, lack of solution implies failure.
- Realism using military judgement based on hard-earned experience.
- Poor understanding of COO/TLC.
- Insufficient research funding stifles innovation.
- Contractors too risk averse, in both technology and commercially, so stifling innovation.

The danger is that solutioneering leads to bids that are unlikely to offer best value for money since it is improbable that the capability offered will best meet the underlying needs of MoD.

3.19.1 Smart Requirements [44]

Prior to the introduction of Smart Acquisition, the procurement process tended to be solution focused, with early attention paid to the characteristics of the equipment to be procured. Much procurement proceeded purely on the basis of an assumed solution, resulting in a concentration on equipment performance rather than user and system needs. Smart Requirements moved that focus to the needs of the users by defining 'what the users of a particular future system will need' and focusing on the requirements for whole systems through-life, rather than just initial procurement.

The intention of Smart Requirements is to define user requirements for a capability rather than a system, and to allocate those requirements to system options identified by Capability Working Groups and developed by IPTs, under the direction of Capability Managers. A through-life 'system of systems' approach is followed, and the capabilities of existing systems improved in relation to changing user demands.

3.19.2 User requirement [45]

A User Requirements Document (URD) is the complete set of individual user requirements (an expression of a single, unique need of one of the users of a system). It is supported by a general description and can be either a document or a database. The URD is ECC's expression of the outputs or results that users require from a system.

3.19.3 System requirement [46]

A Systems Requirements Document (SRD) is the complete set of individual system requirements; an intermediate step between the user requirements and system design. It provides a consistent definition of what a system will do, how well it will do it and any other quality factors, in order to meet the user need. It is supported by a general description and can be either a document or a database. A URD is translated by the IPT into an SRD; an output-based statement of what a system must do to meet these requirements. [47]

3.19.4 Baseline [48]

The baseline is the point at which a requirement is frozen at a known modification state to support another activity (e.g. approval or contract).

3.19.5 Key Requirements (KR) [49]

Those individual requirements which are assessed as key to achieving the mission need, or which are assessed as of particular interest to management are known as key requirements. KRs exist as either:

1 Key User Requirements (KURs)

Requirements or constraints identified from within the wider set of user requirements, assessed as key to the achievement of a mission.

2 Key System Requirements (KSRs)

KSRs are requirements critical to system cost, performance, time or risk [8] that provide management indicators of overall system performance.

3.20 Wants and needs

A want relates to a wish or desire; a need indicates a necessity. The two words have very different meanings when correctly used. People innately feel what is wanted, but have to understand what is needed. Wants align with individual value; needs align with institutional (MoD) value. There is a danger that the wants an individual member of MoD may, as a result of persuasive argument, be erroneously accepted as a need, thus presenting what might be termed a negative value need.

3.21 Capability [50]

A capability is a set of 'operational outcomes or effects that users need to achieve'. It is 'achieved through an integrated set of independent systems.'

3.22 Constraint [51]

In the context of a requirement, a constraint is a restriction on the acceptable solution opportunities (a requirement in itself) e.g. legislation, cost or programme.

3.22.1 Constraints and solutions

Measuring benefits against a specification is relatively straightforward. It is much more difficult dealing with a capability statement that is inevitably fairly loosely worded. Consider the requirement for a capability to 'destroy enemy submarines'. Bids are received for an 'attack' submarine, an ASW frigate and a maritime patrol aircraft.

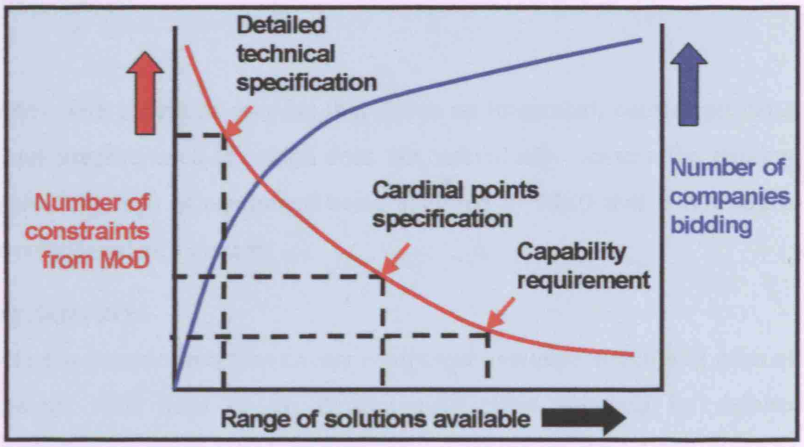

Figure 9 The more constraints placed in an ITT, the fewer solutions are likely to be offered.

Comparing the different capabilities being offered is not going to be easy as each solution has clear advantages in certain situations and equally clear disadvantages in others. For example, a submarine might be a poor solution in the shallow waters of the Arabian Gulf, an aircraft might offer a weak capability against threats in the mid Atlantic, whilst a frigate would be unable to operate in the iced over northern Arctic in winter. Clearly, the fewer the constraints, the more solutions are likely to be offered (See Figure 9). This has been one of the drivers towards issuing capability requirements rather

[8] Effective integration had not been added at the time of writing in August 2005.

than specifications; the specification being agreed by MoD and the contractor once an offering has been chosen. In addition, the more companies that submit bids, the greater will be the number of different solutions offered.

3.23 Trade-off

A trade-off is a balance of compromise that is struck, especially between to desirable but incompatible things.[52] In the MoD acquisition sense it is the determination of the optimum balance between system characteristics (cost, schedule, performance, effective integration, supportability and risk). It is a balancing of factors, all of which cannot be attained at the same time, by compromise usually within the IPT.

3.24 Equipment Plan (EP) and Short-Term Plan (STP) [53]

The Equipment Plan provide a ten-year outline of expenditure in terms of cash and resource cost provisions over the next decade and considers options to match the required spend profile and defence priorities. The Short-Term Plan shows intended expenditure over the next four years, in cash and resource costs terms. From an IPT point of view, these plans include procurement, in-service support and IPT staff operating/running costs for each major project.

3.25 Equipment

The term equipment applies to any piece of defence materiel including components, sub-systems, systems, complete weapons and platforms.

3.26 System [54]

A system is a human-made entity with a defined purpose that draws on integrated, constituent parts, including equipment, people and support, each of which does not individually possess the required overall characteristics or purpose. The type of equipment being acquired by MoD that is relevant to this research can invariably be considered as a system.

3.27 Non-developmental system/item

A non-developmental system/item is generic term that covers equipment available which will meet an approved operational requirement with little or no development effort required by defence organisations. Normally, these sources are commercial products or equipment developed and in use by defence organisations of other nations. In many cases the equipment has to be adapted, modified or improved to meet the requirements set.

3.27.1 Commercial off-the-shelf (COTS)

COTS products or services are designed for and readily available from the commercial market.

3.27.2 Military off-the-shelf (MOTS) and government off-the-shelf (GOTS)

Products and services that have been already developed for an overseas government's military (or other government) forces and are now available commercially may be categorised as MOTS or GOTS.

3.28 Investment Appraisal Board (IAB)

All major projects reaching Main Gate are submitted to the Investment Appraisal Board. The board comprises five senior members of MoD chaired by the Chief Scientific Adviser (CSA) and is responsible for advising ministers on the procurement of major projects for which their approval is necessary. It authorises other expenditure on major defence equipment and reviews procedures for project submissions for its consideration. The AMS Smart Approvals General Instructions and Guidance on IAB and Delegated Approvals for all Investment Projects [55] looks at typical scrutiny issues and evidence that might be sought. The page on 'Value for Money' is shown verbatim below:

Key Point – Does the investment represent a cost-effective means of delivering optimised military capability or business benefits that offers value for money through life?

Typical areas of investigation might include:

- Overall, does the investment offer value for money through life?
  - Is that the *best* value for money for Defence?
  - Could better value for money be obtained by joining up with other requirements?
- Are there documented procurement and support strategies?
  - Will they produce the best value for money?
  - Has the potential for PFI been considered?
  - Is there cohesion with commercial and industrial policy?
- Has there been sufficient analysis and is there sufficient evidence available to justify the investment?
  - Is there a robust Investment Appraisal?
  - Is the project likely to deliver the required military capability or business benefits, taking account of all the required enabling components?
  - Is the pay-back period as short as possible?
  - Have the benefits been fully identified and a tracking mechanism established?
  - What is the impact, if any, on existing infrastructure?
  - Has account been taken of the quality of design as a component of value for money?
- To what extent has consideration been given of trading the performance, time and cost envelope [h] of the investment to deliver better value for money?

The June 2005 document adds: 'Has the potential for co-operation/collaboration and for export sales been considered?' Other points covered in the document are:

Have wider factors (e.g. environmental, legal, HR, TUPE [i]) been assessed and taken into account?

What commercial arrangements exist or are being proposed?

(Are the) key risks to performance, cost and timescale (PCT) identified?

Has potential interest from Parliament and/or the press been considered and planned for?

[h] Still no mention of effective integration in the June 2005 version of the document.

[i] Human Resources, Transfer of Undertakings (Protection of Employment).

3.29 Combined Operational Effectiveness and Investment Appraisal (COEIA) [56]

A COEIA provides the basis for the main investment decision-making process at Main Gate. It is a formal comparison, on a cost-effectiveness basis, of particular equipment options (or combinations of options) for satisfying an operational requirement to assist in down-selecting technology options and carrying out trade-offs to narrow the cost/time/performance envelope during the Assessment Phase. It employs operational analysis to assess the operational benefits of the competing systems in a rigorous, objective and quantitative way.

The four key COEIA activities are to conduct a structured definition of the options and collect data, to assess the Operational Effectiveness (OE) and WLC of all options, to conduct a risk assessment of OE and cost to scope the requirement for sensitivity analysis, and finally to identify the most cost-effective option.

Comment: It is apparent that, as far a value for money is concerned, the 'operational effectiveness' part of the COEIA deals with value while the 'investment appraisal' deals with the money aspect.

It may be important here to consider two separate decisions that have to be made. The first is the decision to spend money on acquiring a capability; the second is the decision to spend the money with a particular supplier. The recommendation for the first comes from the COIEA; the proposal for the second is made by the IPTL.

In response to the question in Parliament: '*Were all the costs and risks fully evaluated through a combined Operational Effectiveness and Investment Appraisal (COEIA)?*' The NAO response on the capability for Strategic Airlift was that MoD '... *presented the costs and all the technical, timescale, commercial, financial and political risks identified for both ... options.*' [57]

MoD has stated that '*Operational Analysis involves assessing the various equipment options in agreed military campaign scenarios reflecting the kinds of operations in which British forces might be involved in the future. Prior to analysis, measures of effectiveness are identified on which comparison is to be based. These need to be few in number and to represent quantitative measures of the achievement of military objectives, not simply measures of system performance. Data and assumptions used are derived by MoD industrial and technical specialists (utilising all available sources) and experts in military tactics.*' [58]

3.30 Business Case

The Business Case (BC) is part of the documentation submitted to the IAB at Initial Gate or Main Gate, making the case for proposed expenditure on the next phases of the project. It includes broader information than is included in the COEIA; in particular 'other factors' such as industrial, political and diplomatic issues.

3.31 Cost effectiveness

Cost effectiveness is a comparative evaluation derived from analyses of alternatives (actions, methods, approaches, equipment, weapon systems, support systems, force combinations, etc.) in terms of the interrelated influences of cost and effectiveness objectives and support costs of the materiel system. Effectiveness is taken to mean only military effectiveness. **Comment**: It may be that there is an implication of cheapest compliant solution in the term cost effective; certainly cost comes before effectiveness, whereas value comes before money in the phrase value for money.

3.32 CADMID[59]

CADMID is the acronym for the current acquisition cycle comprising six stages – Concept, Assessment, Demonstration, Manufacture, In-Service and Disposal – which has replaced the Downey cycle[60]. It includes just two approval stages; Initial Gate and Main Gate.

3.32.1 Concept Phase

Concept is the first of six CADMID acquisition phases, during which the embryonic IPT is formed. The Capability Working Group, assisted by the IPT, produces and baselines a URD defining the current user need, and identifies and costs technology and procurement options for meeting the need that merit further investigation. A Business Case is assembled for the Initial Gate approval.

3.32.2 Assessment Phase

The second CADMID phase beginning after a project has passed Initial Gate. The IPT produces and baselines an SRD, and identifies the most cost-effective technical and procurement solution to the requirement. Risk is reduced to a level consistent with delivering an acceptable level of performance to a tightly controlled time and cost. By the end of the Assessment Phase a Business Case must have been assembled for Main Gate approval.

3.32.3 Demonstration Phase

The third CADMID phase begins immediately after Main Gate approval. During the Demonstration Phase the prime contractor will usually be selected (in some cases this will have happened earlier) and a contract based on the SRD will be placed. The ability to produce an integrated capability will be demonstrated.

3.32.4 Manufacture Phase

The fourth CADMID phase is where the IPT delivers the solution to the military requirement, completing system development and production. The Capability Manager conducts Systems Acceptance and the transfer of the line management of the IPT to the DLO, and the customer function moves from the Central Customer to the Second Customer. During the Demonstration and Manufacture Phases, development risk is progressively eliminated, the ability to produce integrated capability is demonstrated and the solution to the military requirement is delivered within time and cost limits appropriate to this stage.

3.32.5 In-Service Phase

In-service is the penultimate of the six CADMID phases, where the IPT, now under DLO line management, provides effective support to the front line. It maintains the levels of performance agreed with the Second Customer and carries out any approved upgrades,[j] improvements, refits or acquisition increments.

3.32.6 Disposal Phase

Plans are carried out for the efficient, effective and safe disposal of the equipment and its associated support during the final CADMID phase.

3.32.7 Initial Gate [61]

A relatively low approval hurdle, between the Concept and Assessment Phases, Initial Gate is intended to encourage early and full exploration of a wide range of options for meeting a particular capability. A Business Case at Initial Gate should confirm that there is a well-constructed plan for the Assessment Phase that gives reasonable confidence that there are flexible solutions within the performance, cost and time envelope the Central Customer has proposed. Approval at Initial Gate conveys no commitment on the Central Customer or the approving authorities to a project proceeding to or beyond Main Gate.

3.32.8 Main Gate [62]

Main Gate is 'an exacting hurdle', between the Assessment and Demonstration Phases. A Business Case at Main Gate should recommend a single technological and procurement option. Risk should have been reduced to the extent that the Capability Manager and IPT Leader can, with a high degree of confidence, undertake to deliver the project to narrowly defined performance, whole-life cost and time parameters.[k] Potential industrial or political issues must be addressed or resolved at this stage. The parameters agreed at Main Gate will be those used for external reporting and performance measurement with the Treasury and the NAO.

It is normally at this point that a source selection is made when procuring major items of operational equipment. Thus, Main Gate approval is often the point where the prime contractor is chosen to provide a required capability.

3.33 Programme responsibility matrix [63]

This matrix is used to show the individual cost elements over a ten-year period. It thus provides a handy list of headings of all the stages that need consideration under the headings Acquisition (research and development, production and in-service demonstration), Operation, Support (maintenance, post and continuing design) and Disposal. All the entries are project orientated.

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[j] Sometimes DPA will host IPTs carrying out upgrade programmes.

[k] This can be problematic in the case of warships where no prototype is built.

3.34 Incremental acquisition

This is an approach to acquisition in which successive equipment increments, which are flexible in detail, are planned within a scheme of known overall capability requirement and affordability, with each increment providing quantifiable freestanding military capability. **Comment**: This is particularly important when considering the use of COTS IT, where its short life contrasts significantly with that of military platforms.[64]

3.35 System Readiness Levels

The use of System Readiness Levels is a means of assessing the readiness of the design, development and testing regime of systems or sub-systems to be integrated, and whether candidate systems or sub-systems represent a risk to timely integration. The levels are a structured means of measuring and communicating the maturity of technologies within acquisition programmes. The Through-Life Management Plan (TLMP) should bring together key themes of IPTs, systems engineering and improved commercial practices. An outline TLMP should be produced in the Concept Phase and maintained throughout the procurement cycle. It will show the full resources needed to meet the objectives of the project and is recognised by all stakeholders. Clearly, this assessment is crucial in meeting the Smart Acquisition criteria of 'effectively integrated,' but will also provide useful data about risks and particularly risks to delivery timescales.

3.36 In-Service Date (ISD)

ISD is the date by which the equipment or a specified number of equipments will contribute to the operational capability of the service concerned.

3.37 Quality assurance

Quality assurance comprises all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

3.38 ILS (Integrated Logistic Support) [65]

A disciplined management approach, affecting the Central Customer, Second Customer, IPTs and industry, ILS is aimed at optimising equipment whole-life costs (WLC). It includes elements for influencing equipment design and determining support requirements to achieve supportable and supported equipment.

3.39 Availability [66]

Availability is a measure of the degree to which an item is in an operable and committable state at the start of a mission when the mission is called for at an unknown (random) time.

3.39.1 Reliability [67]

Reliability is the ability of an item to perform a required function under stated conditions for a stated period of time. Reliability includes durability. The term reliability is also used as a reliability characteristic denoting a probability of success, or a success ratio.

- Mission reliability is the ability of an item to perform its required mission-critical functions for the duration of a specified mission or life profile.
- Basic reliability is the ability of an item to perform its required functions without failure for the duration of a specified mission profile.

3.39.2 Reliability and maintainability (R&M) [68]

The probability of equipment working correctly when required, and the ease of putting it right, once a failure has occurred are the criteria for R&M. The R&M of equipment are two of the key drivers of its support costs and also encompass the areas of availability, safety, testability and durability.

3.39.3 Maintainability [69]

Maintainability is the ability of an item under stated conditions of use, to be retained in or restored to a specified condition when personnel having specified skill levels under stated conditions perform maintenance using prescribed procedures and resources.

3.39.4 Supportability [70]

Supportability is the degree to which system design characteristics and planned logistic resources, including manpower, meet the system peacetime and wartime availability requirements.

3.39.5 Sustainability [71]

Sustainability is the capability of a system to deliver the required availability level over a complete mission.

3.40 Standardisation [72]

The NATO definition of standardisation is the development and implementation of concepts, doctrines, procedures and design to achieve and maintain the required levels of compatibility, interchangeability or commonalty in the operational, procedural, materiel, technical and administrative field to attain interoperability.

3.41 Interoperability [73]

Interoperability describes the ability of alliance forces, and when appropriate, forces of partner and other nations, to train and operate effectively together, in the execution of their assigned missions and tasks.

3.42 Verification and validation [74]

Verification is action to confirm that the product of a system development process meets its requirement. Validation confirms that the behaviour of a developed system meets the user needs.

3.43 Invitation to Tender (ITT) [75]

An ITT is a package of documents issued (in this case) by MoD to potential contractors, which invites bids for the supply of goods or services against a defined set of terms and conditions and technical specifications.

The content of an ITT will be tailored to the particular circumstances of each procurement. As a minimum it will contain the terms and conditions of the proposed contract, the specification of the acquisition requirement, the support requirements, the quality requirements, the risk-analysis requirement, the delivery programme and details of the marking scheme and compliance matrix against which the tender will be assessed.

3.44 Comparison of lowest-price compliant and value for money

The historical lowest-price compliant method of assessing bids first examines whether the bid complies with the specification and other requirements, such as commercial terms and conditions, included in the invitation to tender. It is a comparatively rigid system of assessment, generally requiring few judgemental decisions. Of those bids that are compliant, the lowest priced one is always selected. This method is unfortunately still being taught to IPT members (See Section 8.12.1).

Several problems occur with this approach. The first is when none of the bids is compliant, but one or more are only non-compliant in a few areas. The second occurs when the lowest price bid or bids are eliminated for a minor non-compliance. It should also be noted that no credit is given for a solution that is better than the requirement. It thus seems that automatically selecting the lowest price compliant bid may well not give the best value for money solution.

3.45 Contractor

The term contractor is used to identify the party that has been contracted to provide a service, facility or equipment to an IPT, on behalf of the Central Customer or Second Customer. Where used by a prime contractor who sub-contracts work, the sub-contractor takes on the role of the supplier and the prime contractor takes on the role of customer.

3.45.1 Prime contractor

A prime contractor has overall responsibility for co-ordinating and integrating the activities of several sub-system suppliers to meet the overall system specification efficiently, economically and to time.

3.46 Commercial issues [76]

There are two ways in which the term 'commercial issues' is used. The first is that described in MoD tender assessment where it is employed to describe the purchase and operating costs. However, in terms of trying to measure value, the term is used here to describe factors such as the ability to compete future requirements and any risk of loosing capabilities that should be retained within the UK industrial base, together with any difference in contract terms and conditions that can be placed on competing suppliers.

3.47 Contract terms and conditions [77]

The terms of a contract define the obligations of the parties to it. English law recognises three kinds of contractual term – conditions, warranties and intermediate terms. In principle, breach of a condition gives a right to terminate the contract, breach of a warranty never gives the right to terminate and

breach of an intermediate term gives a right to terminate where the breach is sufficiently serious (i.e. fundamental to the contract's existence). MoD normally drafts its contracts on the basis that the key terms will be conditions. However, it does not follow that breach of a particular condition will enable MoD or the contractor to terminate the contract. Much will depend on the circumstances of the breach.

Invitations to tender (ITTs) always specify as a minimum the key conditions upon which MoD proposes to contract. Many of these conditions are established terms, which have been developed in consultation with the Confederation of British Industry (CBI) and those Trade Associations that have member companies in the defence or associated industries. The aim of using such conditions is to reduce the number of contract terms that require individual negotiation, shorten the time to contract award and improve clarity, thereby reducing the scope for contractual dispute. However, when comparing competing bids, it may well be that the terms and conditions to which individual suppliers are prepared to accept will vary.

The established conditions fall into 2 categories:

- DEFCONs. These are MoD-specific conditions covering a wide range of contract obligations. Some DEFCONs are supported by associated Defence Forms (DEFFORMs).
- Standard conditions for Private Finance Initiative (PFI) contracts developed by the Office of Government Commerce (OGC).[78] The OGC PFI Standardisation document has been agreed with industry. An MoD version is also published and incorporates MoD-specific requirements such as TUPE and security.

Complex (or 'Bespoke') types of contract also rely on 'narrative' conditions drafted by commercial staff (in consultation with other acquisition team members, industry, customers and legal advisers where appropriate) to cover those aspects specific to the acquisition requirement concerned.

3.48 Intellectual Property Rights (IPR) [79]

The respective rights of the Crown and contractor or other owner to receive, copy, use, have used and disseminate information are defined as IPR.

Many contracts placed by MoD involve the creation or use of one or more forms of Intellectual Property (IP), such as inventions, designs, computer software, manufacturing drawings and technical reports. IP is a valuable commercial asset and, as a result, a legal framework of IPR has evolved which the owner of the rights can use to control or restrict the disclosure and use of the IP in question.

IP may be protected by common law rights, especially rights arising under the laws of contract and of confidentiality, and by legislation, such as patents (which protect inventions), registered and unregistered designs, registered trademarks and copyright. Common law rights cover know-how generally, trade secrets, proprietary technical information of any kind and unregistered trademarks.

IPR governs the use MoD can make of the results of its expenditure on research and/or development. It is especially important therefore that appropriate terms and conditions are included in such contracts in order that MoD may have rights of access to and appropriate rights of use of the results.[1]

3.49 Incentivisation [80]

Incentivisation for new contracts may be positive (rewards for good performance) or negative (sanctions in the event of failure to perform contractual obligations). The following MoD/industry guidelines show the broad Smart Acquisition principles to be pursued in the area of incentivisation that are relevant to achieving best value for money:

1. Making best use of competition at prime and sub-contract level remains the preferred means of supplier selection and for achieving value for money.
2. MoD and industry have common objectives in trying to ensure that incentives produce demonstrable value for money benefits for the MoD and sustained shareholder value for industry. Furthermore, sub-contract suppliers in product-related areas should be nurtured in such a manner as to promote continuing value for money.

MoD intends to develop, with industry, a Supplier Information System which tracks and records past performance and motivates contractors to want to become suppliers to MoD as a result of being able to demonstrate sustained good performance. Additional tools will also be used to promote good performance such as the use of pre-contract award-evaluation techniques, the Contractors Requiring Special Attention (CRSA) list, where performance falls short of required standards and the continued adoption of a 'no acceptable certification, no contract' (NACNOC) procedure to promote effective quality certification standards.

Incentivisation needs to be seen in the light of common objectives to which both MoD and industry subscribe. Relevant factors include maintaining or enhancing industrial competitiveness in home and overseas markets.

MoD and industry both recognise the need to avoid thinking of incentives solely in terms of 'price': and by implication reduced prices. While most forms of incentive (and disincentive or sanction) ultimately have an impact on price, incentives need to be seen in a broader value for money context, such as:

a. Performance and reliability.
b. Improved service delivery.
c. Effective defect investigation and rectification.
d. Improved availability and reliability growth.
e. Good quality with growth potential for improved quality.

[1] These rights are usually quite demanding.

The relevant principal drivers that influence a mutual approach to incentivisation are:

a. Extended contracts and repeat orders in return for sustained good performance.
b. The prospect of re-competition within the partnering, taking due account of past performance.

Almost all incentives and sanctions suggested are financial. The exceptions include operation of past-performance criteria for the selection of bidders, extending the contract if performance is satisfactory or better, and if not, terminating the contract.

3.50 Gainshare [81]

Gainsharing is where the reopening and examining of existing contracts may bring benefit to both MoD and industry and is central to Smart Acquisition. Benefits of gainshare opportunities can include accelerated delivery of the product or service, performance improvements and reduced costs – in other words faster, better, cheaper. Technology advances, changes to trials programmes, innovative support arrangements and income stream opportunities from the transfer of assets are examples of gainshare that may develop while a contract is active.

3.51 Key supplier management [82]

Key supplier management provides strategic and corporate information to the acquisition community on those suppliers who provide essential goods and services to MoD. One of the key elements supporting key supplier management is that of supplier development. This provides an objective assessment of the performance of the supplier whilst under contract against an agreed set of metrics.

3.52 PPP (Public Private Partnerships) and PFI (The Private Finance Initiative) [83]

An integral feature of our (MoD's) new approach to procurement is the use, where appropriate, of Public Private Partnerships. [84]

PPP is a generic term for relationships formed between the private sector and public bodies, including MoD, aimed at introducing private-sector resources and expertise to help provide public-sector assets and services. The term describes a variety of working arrangements from loose, informal and strategic partnerships to 'design, build, finance and operate service' contracts and formal joint-venture companies. The term embraces three types of commercial interfaces with the private sector; the Private Finance Initiative, Partnering and Outsourcing.[85] The hallmarks of PFI, a form of PPP, are:

- A long-term service contract between a public-sector body and a private-sector supplier.
- The provision of capital assets and associated services by the supplier.
- A single unitary payment covering investment and services.
- The integration of design, building, financing and operation in the supplier's proposals.
- The allocation of risk to the party best able to manage and price it.
- Service delivery against performance standards in an output specification.
- A performance related payment mechanism.

Who does what is judged solely on how services are delivered and whether they are high quality and good value for money. MoD has already contracted for several major PFI projects.

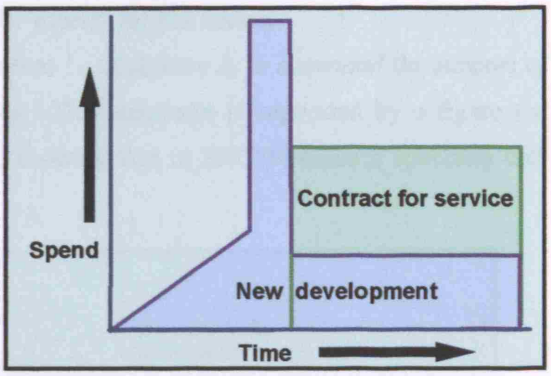

Figure 10 Going the PFI route where equipment is needed will avoid a high up-front spend, though the annual operating cost is likely to be higher than for a conventional contract.

3.53 The department

A number of government documents, aimed at a number of Departments of State not just MoD, are quoted in this thesis. Where extracts refer to 'the department', the word MoD has usually been substituted.

3.54 Multiple-criteria decision-making (MCDM) [86]

MCDM is defined by the International Society on Multiple Criteria Decision Making as '*the study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process.*' These methods and procedures are examined in Section 5.2.

3.55 Exclusions

In order to contain the scope of the research to a manageable level, the following seven items have been excluded from consideration.

3.55.1 Non major operational equipment purchases

The acquisition of major civil works, such as airfields and buildings like Abbey Wood, and less complex items of equipment such as personal weapons, soft-skinned vehicles, support equipment and consumables has been excluded. Thus, procurements made during research by Dstl are not considered nor the majority of those initiated by DLO.

3.55.2 Experience post contract

The aim of this research is to help improve MoD's measurement of relative value during tender evaluation. Once a contract has been let, factors such as subsequent changes to the capability required, an inadequate contracting arrangement or poor performance by the contractor will not be considered. It is easy to be wise after the event and it is not the aim here to suggest how MoD could better learn from its lessons.

3.55.3 Whether MoD's budget represents value for money for the nation

Chapter 10 of the Strategic Defence Review[87] states that *'... if defence is to command the support of the nation it must be seen as good value for money.'* This statement is supported by a figure for general government expenditure, reproduced below, showing that in 2003/04 defence spending will account for just 6% of total government spending.

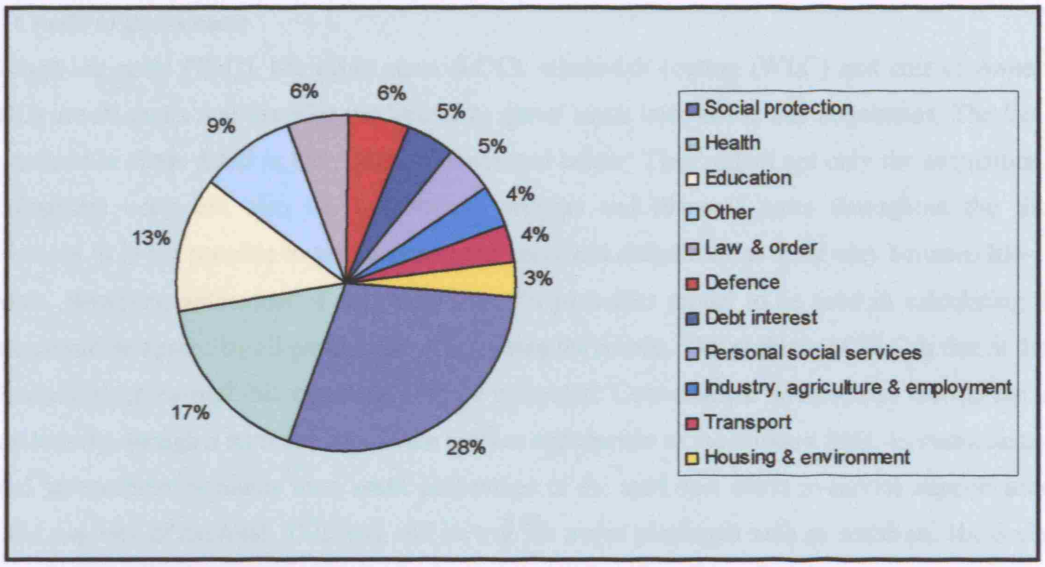

Figure 11 Defence in 2003/04 accounted for 6% of total UK government spending. [88]

While a whole thesis could be written on the subject of the value for money of the MoD budget to the nation, it would divert attention away from the problem for MoD of obtaining value for money in its major acquisitions.

3.55.4 Value for money in terms of uniformed and civilian MoD employees

The value of the members of the armed forces and civil servants working in MoD, particularly those in DPA, will not be considered here. They have relevance both to the acquisition process and also to the human/machine interface with equipment. It is, however, seen as a diversion from the main theme of the proposed research.

3.55.5 Money

In the term 'value for money' the word 'money' needs to be considered. Compared to the word 'value', this is a comparatively straightforward task. Money can be viewed in several ways. There is the money involved in the initial purchase and there is the money spent in operating and providing support during the life of what has been purchased. Cost of ownership includes the initial purchase price as well as any financing costs, running costs and the cost of lifelong support including disposal. This latter money is difficult to measure at the onset of a new project, as the uncertainties lie in estimating what will happen in the future life of the project, once it has been delivered. There is, in

many cases, the money spent on the crew who operate and support what has been purchased [m] and it is necessary to look at a discounted cash-flow calculation to take into account when the money is spent, and the impact of inflation. Finally, exchange-rate variations can have a major effect on the sterling value of foreign imports. However, compared with an examination of 'value', 'money' is a relatively straightforward parameter to measure.

1 Cradle to grave costs

Through-life costs (TLC), life cycle costs (LCC), whole-life costing (WLC) and cost of ownership (COO) are all terms that describe the 'cradle to grave' costs involved in any acquisition. The last two are defined in some detail in the AMS and discussed below. They reflect not only the acquisition and development costs but also the operational, support and disposal costs throughout the life of equipment. It is not possible to give accurate mathematical definitions as these vary between life-cycle models. However, agreement of the definition of a particular model to be used in calculating these costs should be agreed by all parties before accepting the results. The problem of TLC is that at the bid evaluation stage through-life costs can only be estimated. Conventional wisdom has viewed the issue as an iceberg, though a surfaced submarine is more appropriate to the military field. In many cases, the initial procurement accounts for a small percentage of the total cost while in-service support account for the majority of the total. This may still be true for major platforms such as warships, but is clearly not so for missiles like TOW, which are sealed in their launcher tubes and require no maintenance or spares prior to launch. The only in-service costs involve storage, transportation and operator training.

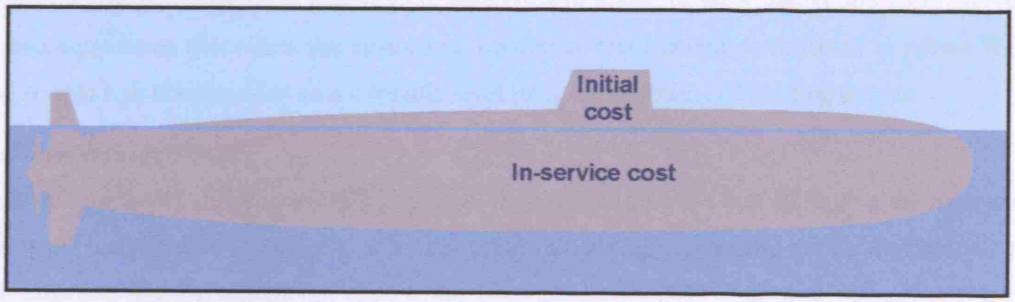

Figure 12 The typical relationship between initial procurement and through-life costs – a submarine with less than 10% above water may be more representative than an iceberg.

The difficulty at the time of supplier selection is that estimates of cradle to grave costs are only likely to vary significantly between potential contractors where the offerings have major differences. It should be relatively straightforward to measure the differences in these costs between a diesel-electric and a nuclear-powered submarine, between a wheeled reconnaissance vehicle and a tracked one, or between a single-engine aircraft and twin-engine one. Unfortunately in the majority of cases, solutions tend to converge and models are not yet accurate enough to provide accurate cost discrimination.

[m] As an example, a single seat aircraft is cheaper to operate in aircrew terms than a two-seater.

Consideration also needs to be given to the fact that some suppliers habitually sell equipment cheaply and '*the way they get their money back usually is in the cost of support.*' [89]

The final problem is where one potential contractor is UK based and the other located overseas and quoting in a foreign currency. Trying to predict how exchange rates will vary over the first five years will be difficult. How they will vary over the lifetime of the equipment, which may stretch to around half a century, will be impossible.[n]

Whole-life costing (WLC) [90]

Whole-life costing is a continuous process of forecasting, recording and monitoring costs throughout the life of equipment with the specific aim of optimising its military capability. It covers the total resource required to assemble, equip, sustain and operate a specified military capability at agreed levels of readiness, performance and safety. It includes the costs to develop, procure, own, operate and dispose of or re-deploy defence equipment. It will involve any stakeholder that can identify costs that are clearly and directly attributable to the equipment. Estimates can be produced using a variety of tools and techniques but should in any event be reconcilable to EP and STP data (as appropriate).

When procuring equipment or enhancing a defence capability, it is a requirement to identify whole-life costs for each potential option. WLC is used to inform the decision-making process and identify budgetary implications and hence facilitate long-term planning. It is a key to the trade-off process and is linked to performance and schedule.

Whole-life costing is crucial to meeting the objectives of faster, cheaper, better and more effectively integrated acquisition that meets the customers' capability requirement. Investment in robust WLC is needed so that risk is reduced to an acceptable level prior to the setting of binding targets.

Cost of Ownership (COO) [91]

When MoD purchases major items of equipment, it considers both the cost of buying the item and the ongoing cost associated with using it. It is vital to be able not only to afford to buy the equipment but also to afford to use the equipment once it has been acquired. COO is used to identify and manage equipment-related resources and costs.

A COO analysis shows the resources consumed each year in procuring, operating, supporting, maintaining and disposing of an item of military equipment throughout its life. COO is used:

- To determine equipment affordability in cash and resource terms (i.e. at Initial Gate and Main Gate).
- To manage MoD-wide costs associated with assets throughout their lives.

COO is compiled as part of the Through-life Management Plan (TLMP). This document will provide a framework for co-ordinating the planning and control of equipment throughout its life cycle.

[n] Fifty years ago, German DM12 = £1, today DM3 = €1.5 = £1. Over the last thirty-three years the US dollar/UK pound exchange rate has varied from a high of 2.65 to a low of 1.05.

The four main benefits of COO considerations can be summarised as:

- Enabling MoD to achieve maximum capability from its scarce resources.
- Making it easier to manage peaks and troughs in resources.
- Providing a link between the 10-year EP and the 4-year STP.
- Leading to decisions being taken that optimise the benefits to the MoD as a whole.

All projects reaching Main Gate and being submitted to the IAB will include a COO analysis. This will provide a complementary view to the existing requirement for an Investment Appraisal.

3.55.6 Value defined as monetary worth

Phrases such as 'Percentage share by value of contracts placed' are using value in the sense of monetary worth and are excluded from further consideration.[92]

3.55.7 Negative value

Negative value implies 'value' in the financial sense and is clearly apparent in cases such as switching costs. These are costs associated with the impact on other parts of the system resulting from changing one part of the system. This is often occurs because of an incompatibility problem. Consider the example of a new rifle, or replacing the gun of a tank with a new one. Both may offer better value in the sense of improved range, accuracy, rate of fire and weight, but may offer negative value if they use ammunition of a different calibre, requiring all stocks of existing ammunition to be replaced. Since negative value can always be reduced to financial terms, it is excluded from further consideration.

4 REVIEW OF RELEVANT LITERATURE

Much has been written on the subject of value and decision-making. Value for money has also realised some attention, but the problem of what defines value and how to measure it has achieved less consideration. It thus appears that the overall aim of this research does indeed cover new ground. This section provides an overview of thirty-nine books and papers, the first twenty-one being UK government publications, that have been examined during this research. The MoD Acquisition Management System is examined in Section 7.

4.1 The Green Book – Appraisal and Evaluation in Central Government [93]

The 'Green Book', as might be expected of a Treasury document, concentrates mainly on financial aspects of the appraisal of projects. It also regularly uses the term 'value' in its monetary sense, but occasionally in the non-financial sense. It also uses the term 'benefits' where this thesis uses 'value'.

There are five activities covered by the 'Green Book', of which the fifth, '*Major Procurement Decisions – Decisions to purchase the delivery of services, works or goods, usually from private sectors*', is clearly apposite to this research. The 'Green Book' is aimed at those required to conduct a basic appraisal or evaluation of a project or programme. The role of appraisal includes cost-benefit analysis, which quantifies in monetary terms as many of the costs and benefits of a proposal as feasible, including many for which the market does not provide a satisfactory measure of economic value. It also embraces cost-effectiveness analysis that compares the costs of alternative ways of producing the same or similar outputs. Each option is then appraised by establishing a Base Case; the best estimate of its costs and benefits.

These estimates can be adjusted by considering different scenarios, or an option's sensitivity to change can be modelled by altering key variables. More fully, the appraisal may grow as follows:

1. Identify and value the costs and the benefits of each option.
2. If required, adjust the valued costs and benefits for:
   a. Distributional impacts (the effects of proposals on different sections of society).
   b. Relative price movements.
3. Adjust for the timing of the incidence of costs and benefits by discounting them, to obtain their present values.
4. If necessary, adjust for material differences in tax between options.
5. Adjust for risk and optimism to provide the Base Case, and consider the impacts of changes in key variables and of different future scenarios on the Base Case.
6. Consider unvalued impacts (both costs and benefits), using weighting and scoring techniques if appropriate.

Comment: This raises several interesting factors relating to major operational equipment acquisitions. In particular, the sixth item: '*Consider unvalued (in a financial sense) impacts (benefits) using weighting and scoring techniques if appropriate*' highlights the need to evaluate benefits that cannot be translated into financial terms; the subject of this research. The OGC Gateway Review (see Section 4.4) is quoted as particularly applicable to the appraisal of programmes and projects.

4.1.1 Estimating the value of benefits

The purpose of valuing benefits is to consider whether an option's benefits are worth the cost and to allow alternative options to be compared systematically in terms of their net benefits or net costs. The general rule is that benefits should be valued (financially) unless this is clearly impracticable. Even if it is not possible to value all the benefits of a proposal, it is important to consider valuing the differences between options. Most appraisals will identify some costs and benefits for which there is no readily available market data. In these cases, a range of techniques can be applied to elicit values, even though they may in some cases be subjective. There will be some impacts, such as environmental, social or health impacts, which have no market price, but are still important enough to value separately.

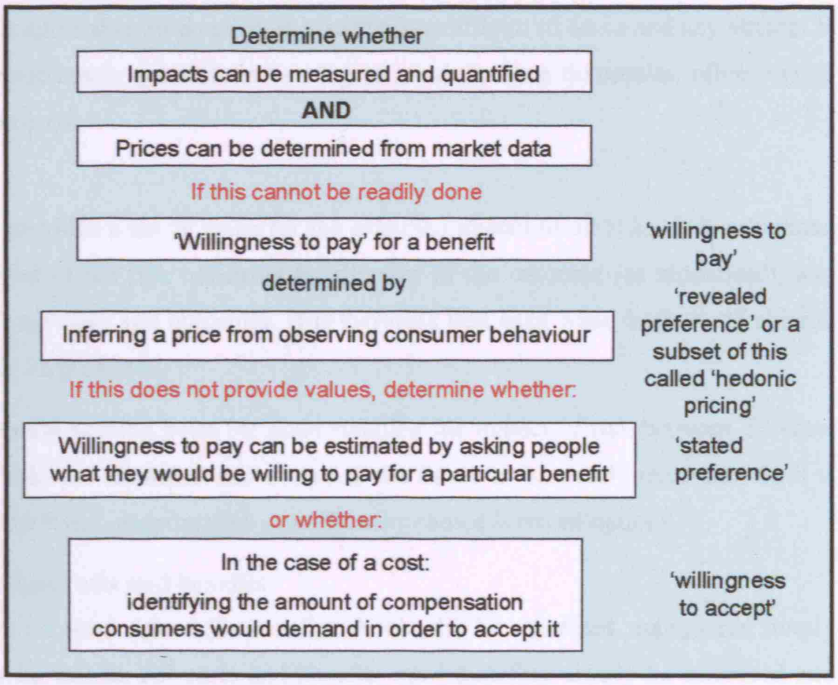

Figure 13 Valuation techniques from Box 10 in the 'Green Book.'

4.1.2 Optimism bias

The book states that there is a demonstrated, systematic, tendency for project appraisers to be overly optimistic. Many project parameters are affected by optimism – appraisers tend to overstate benefits, and understate timings and costs, both capital and operational.

To redress this tendency, appraisers should make explicit adjustments for this bias. These will take the form of increasing estimates of cost and decreasing and delaying the receipt of estimated benefits. Sensitivity analysis should be used to test assumptions about operating costs and expected benefits.

Adjustments should be empirically based and corrected for the unique characteristics of the project in hand. When such information is not available, data should be collected to indicate estimates of optimism, and in the meantime the available data that best fits the case in hand should be used. Cost estimates and adjustments for optimism should be reviewed independently before decisions are taken.

In the case of selecting one of several contractors' offerings, optimism bias is likely to affect all offerings, but there may be different degrees of optimism in the views of the likely performance of the different contractors. Furthermore, there may be areas where different contractor's offerings vary significantly. There may offer totally different ways of providing a particular capability, or there may be different exchange rate and inflation risks.

Comment: NAO Major Project Reports (see Sections 4.5 - 4.7) suggest that there may be some optimism bias both in terms of timescale and cost, though very rarely in performance. While the aim of adjusting for optimism is admirable, in practice, it is extremely difficult to do so and any attempt is likely to provide only a crude result, particularly bearing in mind the long timescales, often several decades, between similar projects.

4.1.3 Risk

An 'expected value' (EV) provides a single value for the expected impact of all risks. It is calculated by multiplying the likelihood of the risk occurring by the size of the outcome (as monetised), and summing the results for all the risks and outcomes. It is therefore best used when both the likelihood and outcome can reasonably be predicted.

An expected value is a useful starting point for understanding the impact of risk between different options but however well risks are identified and analysed, the future is inherently uncertain. So it is also essential to consider how future uncertainties can affect the choice between options.

4.1.4 Considering unvalued costs and benefits

Costs and benefits that have not been valued (financially) should also be appraised, not ignored simply because they cannot easily be valued. All costs and benefits must therefore clearly be described and should be quantified where this is meaningfully possible.

Research may be needed to determine the best unit of measurement. Alternative non-monetary measures might be considered most appropriate. In many cases, more than one measure should be included to capture the different impacts of the proposal and the different dimensions of those impacts.

The most common technique used to compare both unvalued costs and benefits is weighting and scoring (multi-criteria analysis). The basic approach to weighting and scoring involves assigning weights to criteria, and then scoring options in terms of how well they perform against those weighted criteria. **Comment:** This is the approach MoD takes in the 'operational effectiveness' part of the COEIA, but MoD recommends highlighting wider factors in the Business Case rather than weighting them, and not combining them into the COEIA.

The weighted scores are then summed, and these sums can be used to rank options. An even simpler method is to list the required performance criteria (critical success factors), and assess options in terms of whether they meet them or not. **Comment:** This may be a reasonable approach when, for example, acquiring platforms, but becomes much more difficult to define and implement for C^3I systems

In practice, the weight to give to factors that are thought to be important by key players cannot be decided by 'experts'. They inevitably incorporate the judgments of stakeholders and decision-makers. The risk that they are weighted towards acceptance of more expensive solutions by those who would enjoy the potential benefits should be tempered by at least one stakeholder representing the opportunities that an expensive solution would be foregone elsewhere.

4.1.5 Decision guidelines

If a full cost-benefit analysis has been undertaken, the best option is normally the one with the highest risk-adjusted net present value. In cost-effectiveness analysis, the option with the lowest net present cost should be the best, assuming that the cost estimates are as accurate and reliable as possible. If there is a budget ceiling (**comment**: isn't there always one), then the value of benefits should be maximised.

In practice, other factors will also affect the selection of the best option, in particular the consideration of unvalued costs and benefits. Weighting and scoring techniques are useful in comparing different options in terms of the same criteria. However, as scores are not expressed in monetary terms, judgment is then required to compare the results of weighting and scoring with the cost benefit or cost-effectiveness analysis. The two analyses should complement each other and may indicate that further analysis is required before a decision can be reached. Fully involving stakeholders is very important in making judgments between monetised and non-monetised effects.

4.1.6 Comment on the Green book

While carefully following the guidelines given in the 'Green Book', it seems that MoD is the government organisation least likely to be able to convert benefits and value into monetary terms. Thus it has to rely for the majority of its analysis of competing offers on weighting and scoring techniques but although MoD scores options in terms of how well they perform against weighted criteria in the COEIA, other wider factors are separated and found only in the Business Case. Furthermore, the removal of optimism bias is likely to prove exceeding difficult for major procurements with their extremely long lives. It is interesting to note that this document does not make any mention of potential contract-cancellation costs, yet there is clearly a financial cost, as well as a timescale penalty (negative benefit).

4.2 Getting value for money from procurement [94]

This document by NAO and OGC quotes a number of ways in which better value for money from procurement can be achieved. Some are not relevant to this research, the others that are pertinent are:

- Getting an increased level or quality of service at the same cost.
- Ensuring that user needs are met but not exceeded.
- Specifying the purchasing requirement in output terms so that suppliers can recommend cost-effective and innovative solutions to meet that need.
- Optimising the cost of delivering a service or goods over the full life of the contract rather than minimising the initial price.
- Introducing incentives into the contract to ensure continuous cost and quality improvements throughout its duration.
- Aggregating transactions to obtain volume discounts.
- Developing a more effective working relationship with key suppliers to allow both MoD [o] and suppliers to get maximum value from the assignment by identifying opportunities to reduce costs and adopt innovative approaches.

Improvements in value for money fall into three areas. The first two are relevant while the third is largely outside the scope of this research.

1. Those aimed at getting more value from money by negotiating improved deals with suppliers (reduced cost and/or better quality), or aggregating demand to get greater leverage on suppliers.
2. Those aimed at improving project, contract and asset management.
3. Those aimed at reducing the cost of purchasing and the time it takes; for example, the administrative effort in processing an order, seeking and evaluating tenders, and taking delivery of the goods ordered.

The document considers setting value for money in the long as well as the short term. In the case of goods and services, which have a working life of many years, there is a need to ensure they are cost effective over their whole working life. This means taking a long-term view and not focusing on the lowest purchase price at the expense of long-term value for money. Long-term procurement commitments also need to be able to deal with change, such as the benefit of advances in technology.

The risks associated with PFI contracts are examined and the comment made on page 30:

'If the private sector are asked to accept responsibility for a risk that is within their control, they will be able to charge a price for this part of the deal which is economically appropriate. However, if MoD seeks to transfer a risk that the private sector cannot manage, then the private sector will seek to charge a premium for accepting such a risk, thereby reducing value for money. MoD should therefore seek to achieve not the maximum but rather the optimum transfer of risk, with individual risks allocated to those best placed to manage them.'

Procurements risks and how to manage them are considered as indicated in the table, which also, in the right-hand column, includes some comments on MoD's position.

[o] Throughout this review, 'MoD' has been used in place of 'the procuring department'.

Risk	How to deal with the risk	Where MoD stands
Price does not represent value for money	Purchase through competition with regular benchmarking to ensure prices remain competitive	Competition is almost always used
Goods and services purchased in uneconomic quantities	Assessment of optimum order quantity to maximise opportunities to get in the best price	Major equipment procurements are normally split into tranches
Suppliers fail to deliver	Assessment of supplier's financial viability and past performance, having a good knowledge of supplier markets and supply chains	The dominance of a single UK contractor – BAE Systems – makes it difficult to deal with this problem
Goods and services are not of appropriate quality	Clearly defining quality requirements up front and monitoring quality of goods and services received. Link payment to performance and consider staged payments for delivery of goods and services	This is normally only an issue in the sense that long delivery times can make equipment obsolescent at delivery

The risks associated with PFI contracts are listed as:

- Design and construction risks.
- Commissioning and operating risks.
- Demand risk.
- Residual-value risk.
- Technology and obsolescence risk.
- Regulation risk.
- Project-financing risk.
- Disposal risk.
- External-finance risk.
- Risk of contractor default.
- Refinancing.
- Political-business risk.

Partnering and collaborative working are examined and the following factors are listed:

1. Advantages
   - Reduced procurement costs with less frequent formal competitions.
   - Suitable for developmental projects where it is difficult to specify the goods and services required, but choosing the right partner is crucial.
   - Gives the supplier increased continuity of work that allows it to offer better value for money through reduced costs or better quality of service.
2. Risks
   - Placing larger contracts out to tender may squeeze smaller companies out of the market and raise costs in the long term.
   - Procurement competitions are big, complex and expensive.

- MoD may tie itself into a contract for too long and deprive itself of the opportunity to take advantage of new developments in the market.
- Relationships with the supplier become too cosy and MoD becomes dependent on it.

3. Safeguards
   - An up-to-date knowledge of MoD's requirements and the market in which suppliers operate, which is used to develop appropriate procurement and contract strategies.
   - Balancing the cost of procurement against the value of the contract, for both MoD and suppliers, to choose an appropriate procurement strategy.
   - Risk analysis of the contract strategy and management of those risks.
   - Subjecting the contract to open competition at appropriate intervals.
   - Specifying in the contract the need.

4.2.1 Comment on 'Getting value for money from procurement'

Much of the advice provided in this document is already being implemented by MoD. What is important is the concentration on issues other than the tenets of Smart Acquisition; faster, cheaper, better and more effectively integrated. Most of these other issues fall into one of two categories, detailed in Chapter 8; other factors or contract terms.

It is interesting to note that equipment manufacture may be split by MoD for one of two reasons. The first is on the basis of affordability, where significant numbers are required for a given capability and production is split into a number of tranches to spread both the expenditure and the resources needed to enter the equipment into service. An example is the Eurofighter Typhoon. The second is more often politically driven, where the total production requirement is split between two companies to ensure their survival (or to boost regional employment) and/or to give at least two competitors for future bids for similar equipment. An example of this approach is the contract with two companies for the Type 45 destroyers. Figure 14 show the typical financial impact of such approaches. Does this represent a value for money approach?

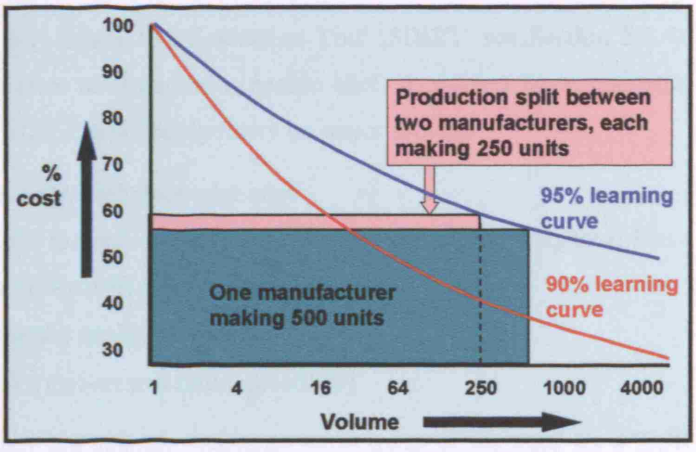

Figure 14 The increased cost of splitting manufacture equally between two suppliers will result in a 2½% increase in price with a 95% learning curve and a 5% one with a 90% learning curve, all other things being equal.

In addition, the recommendation that user needs are met but not exceeded has its obvious merits but, in the competitive environment of war, an offer that exceeds the user's stated needs may provide a battle-winning capability that has not been thought of by the user. This suggests that before declining such an offer, it may be advisable to reassess the original requirement to see whether an improved capability (particularly due to new technology) is needed.

4.3 Best Practice – Value for Money Evaluation in Complex Procurements – Key questions on VFM you should ask through the procurement process [95]

This document by OGC starts by proposing that a check is made that MoD's [P] investment objectives and priorities have been set. It continues by proposing that supplier capabilities are assessed and asks the following pertinent questions:

- Do the competing suppliers have the required capabilities (including staff, support systems and experience) to deliver?
- Can they meet the requirement set out in the advertisement?
- How does the supplier's track record on delivery performance match the size, scope and complexity of the requirement?
- How does the supplier's track record on team working, or partnering, relate to the aspirations of MoD?
- Does MoD believe that it can achieve a good working relationship with each of the suppliers?
- Are there any potential conflicts between any of the suppliers retaining their core business directions whilst fully meeting MoD requirements?
- Is the knowledge and experience of MoD's procurement professionals being used to their full extent in this assessment?

Comment: Where an IPT uses the Soft Issues Bid Evaluation Tool (SIBET, see Section 5.3.4), potential suppliers should provide sufficient information to enable MoD to answer these questions satisfactorily. Unfortunately, the use of SIBET is not compulsory on major projects.

The document then considers benefits in the evaluation and asks:

- Are all the criteria for non-financial factors relevant? Are they prioritised and weighted? Have the assessment team agreed the measurement methodologies?
- Can the suppliers deliver to appropriate quality standards?
- Do the criteria clearly reflect MoD's current and future priorities?

Comment: On the whole, MoD already has suitable standards set in terms of the need for a KUR and the use of MACE (Multiple Attribute Choice Elucidation) during evaluation, as well as in documented Defence Standards.

[P] Throughout this review, 'MoD' has been used in place of 'the procuring department'.

The costs in the evaluation are considered next, an entirely money issue, before indicating the need to revisit the assumptions in the Business Case through the procurement. The only relevant issues are:

- Meeting business need – does the bid cover everything that is currently needed, to the required quality of service?
- Most appropriate option – have all appropriate options been considered before narrowing down the choices for the way forward?
- Achievability – does the supplier fully understand the implications of providing the equipment and implementing the service? Can the supplier support this understanding with appropriate plans for risk management and quality improvement?
- Affordability – are all relevant costs included?

The section dealing with 'are funds still available?' in fact highlights issues more related to value than to money:

- Realism – can the supplier provide and maintain quality services for the quoted price? Does MoD believe that the supplier can make an appropriate return?
- Risk – do the risks rest with those parties best able to control them? **Comment:** excluding risks beyond their control.

The document defines 'Value for money' as '*the optimum combination of whole-life cost and quality (or fitness for purpose) to meet the user's requirement.*' It also states that this is rarely synonymous with lowest price. Other issues addressed include commitment from the top and openness involving the exposure to suppliers of how their offers will be evaluated. This includes the relative priorities of the criteria, accountability and the business requirement, including any specified levels of quality or standards of performance and service that must be tested critically for continuing business need, cost-effectiveness, affordability and value for money over the life of the contract.

In looking at selection based on European Community rules, the following statements are made:

- A selected shortlist of the suppliers must have proved they are most suitable for consideration as competitors to provide what is required. Both financial and non-financial factors are likely to feature in a set of weighted selection criteria established and agreed prior to inviting expressions of interest. The suppliers must be advised accordingly. The criteria will be based on:
  - Financial and economic standing.
  - Technical capacity (including track record) and ability (for services contracts only).
  - Ineligibility e.g. insolvency, grave business misconduct etc.
- The key non-financial factors within the areas of technical capacity and ability should include:
  - Aspects of relationship management and team working relevant to the business context of the requirement.
  - The specific demands of a partnering approach where it is the intended relationship model.

- Approaches to risk allocation and management.
- Project delivery.
- Quality of products/service delivery.

In examining awards based on European Community rules, the relevant points include:

- The award should be made to the supplier that has submitted the best value for money bid to meet the specified requirements.
- The award criteria will be a combination of both financial and non-financial factors. Key non-financial criteria will usually include areas of deliverability, service quality, innovation, organisational culture, environmental issues, risk management and partnering/team working. **Comment:** These are rather broader than the key aims of Smart Acquisition – faster, cheaper, better and more effectively integrated.
- To promote price realism and solution deliverability, the recommended approach to value for money evaluation is to differentiate the financial and non-financial criteria for consideration in separate strands. Attempts to balance these criteria during the process should be avoided. Via a methodology agreed (by the IAB) the two strands should be brought back together prior to the award decision. Unless the best quality bid is also the lowest price bid, the IAB must come to a judgement balancing the business risks. **Comment:** This is discussed further in Chapter 8 and is one of the crucial problems for MoD.
- The mix of criteria and any weighting applied to each individual criterion will depend on the nature of the specific procurement, the business requirement and its context within the operations and strategy of MoD. The criteria chosen must support the value for money definition and should not relate to other objectives extraneous to the specific procurement.
- Suppliers must be advised of the requirement's criteria and their relative priorities.

In considering supplier debriefing, the point is strongly made in the document that there is a general perception amongst suppliers that bids are usually won on lowest price alone, with the inevitable adverse knock-on effect on the quality and whole-life cost aspects of bids.

4.3.1 Comment on Best Practice

On the whole, while MoD follows OGC '*Best Practice – Value for Money Evaluation in Complex Procurements*', there are still areas where improvements can be made if 'best value for money' as opposed to the 'cheapest compliant solution' is to be acquired. The mandated use of SIBET would help to obtain sufficient information about potential suppliers. 'At lower risk' could beneficially be added to the existing key aims of Smart Acquisition.

4.4 OGC Gateway™ Review 3: Investment decision [96]

This document is part of a wider process, shown in Figure 15 overleaf. The Gateway Review process provides a series of checklists for use by government departments. Review 3 covers the period that lies

just between competitive-procurement award and implementation of the ensuing contract. From the point of view of this research, the key purpose of the review is to confirm that the recommended contract decision, if properly executed within a standard lawful agreement, is likely to deliver the specified outputs/outcomes on time, within budget and will provide value for money. It recommends, in assessing proposed solutions that several areas should be probed and evidence expected from them.

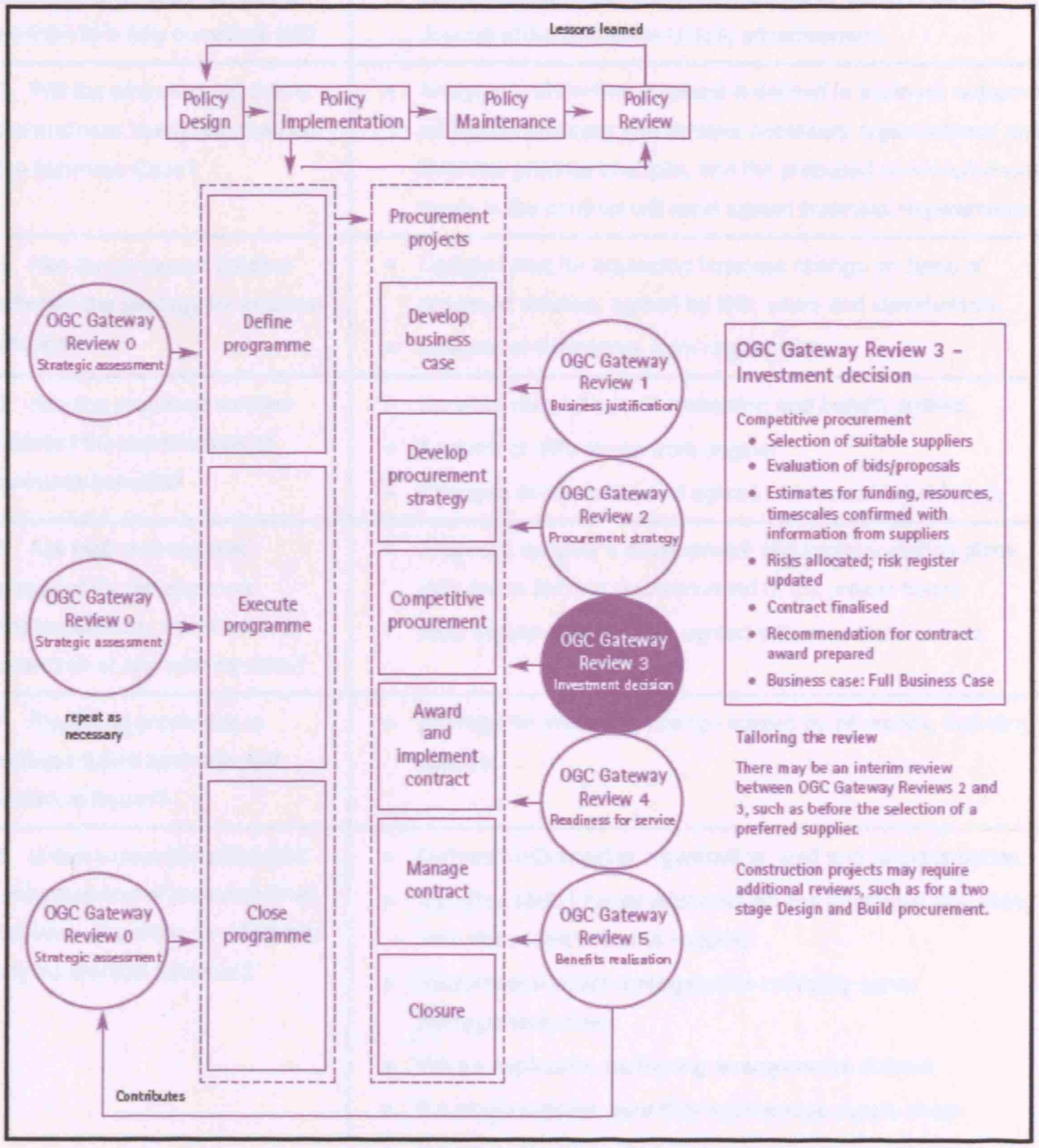

Figure 15 The Gateway Review [q] process showing where Review 3 fits in the appraisal methodology.

The review recommends eleven areas to be probed during the assessment of proposed solutions and provides suggestions of the evidence expected in the table overleaf, (from OGC pages 7/8 customised for MoD). This gives rise to some concerns when it comes to achieving best value for money.

[q] This diagram is reproduced from page 2 of the OGC Gateway™ Review 3: Investment decision.

Areas to probe	Evidence expected
1. Does the proposed solution meet the business need?	• The selected bid fully complies with all requirements. • Consultation with stakeholders during evaluation and their acceptance of the proposed solution.
2. Have suppliers proposed any alternatives or other options in addition to a fully compliant bid?	• Assessment of options to show how these benefit project outputs/outcomes and still within scope of OJEU (Official Journal of the European Union) advertisement.
3. Will the proposed bid deliver the business need described in the Business Case?	• Analysis to show that proposal is defined in business outcome terms, the business can achieve necessary organisational and business process changes, and the proposed services/service levels in the contract will meet agreed business requirements.
4. Has the proposed solution affected the strategy for business change?	• Updated plan for managing business change on basis of proposed solution, agreed by IAB, users and stakeholders • Analysis of differences from original plan.
5. Has the proposed solution affected the expectations of business benefits?	• Updated plan for benefit realisation and benefit profiles. • Analysis of differences from original. • Changes documented and agreed with users/stakeholders.
6. Are MoD and supplier prepared for development, implementation, transition and operation of any new services?	• Proposed supplier's development and implementation plans included in bid and recommended to the project board. • MoD implementation plan agreed with user stakeholders.
7. Plans and processes to address future business and technical issues?	• Strategy for managing change agreed by all parties, including supplier.
8. Is there clear allocation and understanding of responsibilities between all parties, in addition to any contractual liabilities?	• Defined MoD/supplier organisation, staff and responsibilities. • Identified MoD internal relationships and interfaces describing 'who does what' with the supplier. • Reciprocal supplier arrangements including senior management roles. • Where applicable, partnering arrangements defined. • If a single supplier, how they will manage supply chain. • If multiple suppliers, how MoD will manage the interfaces. • Evidence that MoD & supply team will work together as an IPT.
9. Are resources available for the business to fulfil its obligations within the contract?	• Plan for implementing the new contract, identifying the quantity, type and quality of resources required. • Formal management acceptance of resource requirements.

10. Technical implications assessed?	• Evidence demonstrates proposal is technically acceptable.
11. Does the project have resources with appropriate skills and experience to achieve the intended outcomes of the investment?	• Plans for providing required 'intelligent customer' capability, with names allocated to major roles. • Internal/external commitment to provide required resources. • Job descriptions for key project staff. • Skills appraisal undertaken/plans for addressing shortfalls.

4.4.1 Comment

Item 1 expects evidence showing 'the selected bid fully complies with all requirements'. This suggests that bids with minor non-compliances may be rejected even if they offer best value for money. Item 2 probes alternatives and options, but what happens if they provide better value for money but are not within the scope of the OJEU advertisement? Item 7 highlights the need to address future business and technical issues at the time of contracting. Item 9 probes the resources within the supplier organisation to undertake the project and could be resolved for MoD by the use of SIBET.

4.5 NAO Ministry of Defence Major Projects Report 2000 [97]

This report, covering the year to 31 March 2000, includes data on 30 key MoD projects. It includes data on technical performance, as well as cost and timescales. Of the four main causes of changes to project costs since Main Gate approval, changed requirements are likely to have the main impact on the value part of 'value for money'. Figure 16 gives an analysis of percentage cost over/under run per year against elapsed time since Main Gate approval. It is interesting to speculate whether a more expensive bid that did not overrun its costs might have offered MoD better value for money.

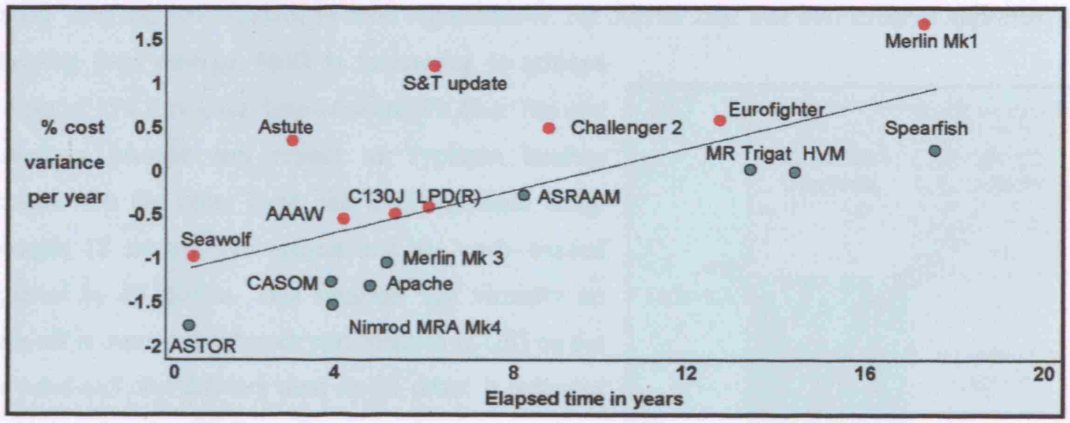

Figure 16 Analysis of cost overrun/under runs by elapsed time.[r]

[r] The following abbreviations are used in Figures 16 and 17: AAAW – Advanced air-launched anti-armour weapon, HVM – High velocity missile, ASRAAM – Advanced short-range air-to-air missile, LPD(R) – Landing platform dock (replacement), ASTOR – Airborne standoff radar, MR Trigat – Medium-range Third Generation Anti-Tank Guided Weapon, C130J – Lockheed Hercules aircraft, S&T – Swiftsure & Trafalgar class submarines, CASOM – Conventionally-armed stand-off missile.

In-service date (ISD) slippage also has a major impact on value, and the Figure 17 shows in-service date variation since Main Gate approval.

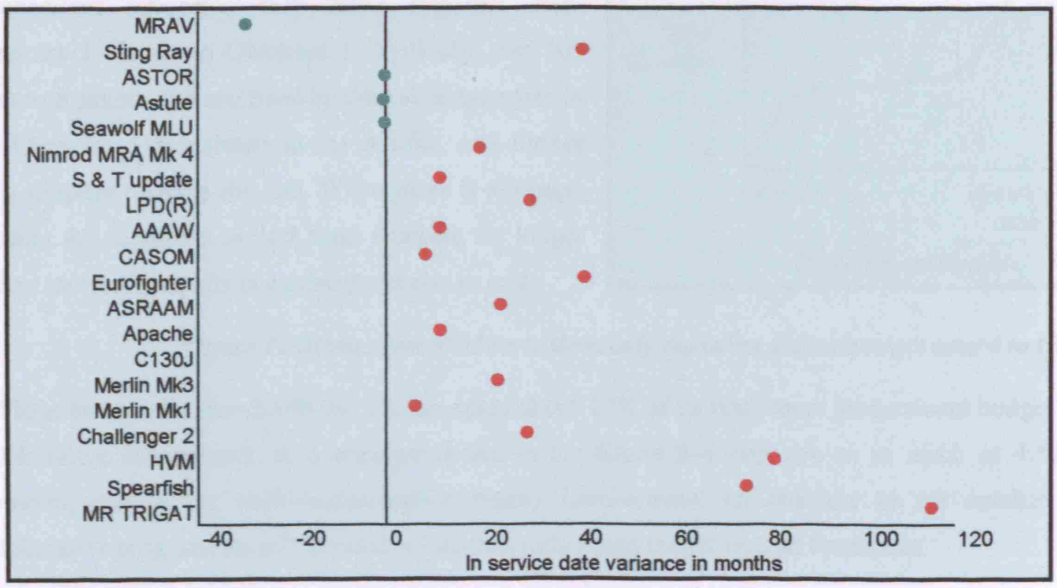

Figure 17 Delays in the in-service dates of major projects.

Comment: What this report really shows is the care needed during source selection in assessing whether the estimated delivery is realistic and if the quoted cost will be achieved, thus meeting the value for money criteria implicit in the original selection.

4.6 NAO Ministry of Defence Major Projects Report 2003 [98]

This document provides some interesting statistics on the top twenty MoD projects. In the section headed '*Projects are expected to meet requirements, but overall cost and time exceeds approval*' the following facts emerge. MoD is forecasting to achieve 173 out of 174 Key User Requirements (99.4%). The one missed is historic and relates to Typhoon landing distance. On the other hand, the total timescale delay averages 18 months per project and the costs exceed approval by £3 billion. This suggests that virtually no trade-off is occurring between performance (KUR) on the one hand and cost/delivery time on the other. It indicates the high value that MoD places on performance and the relatively low value it places on delivery time.

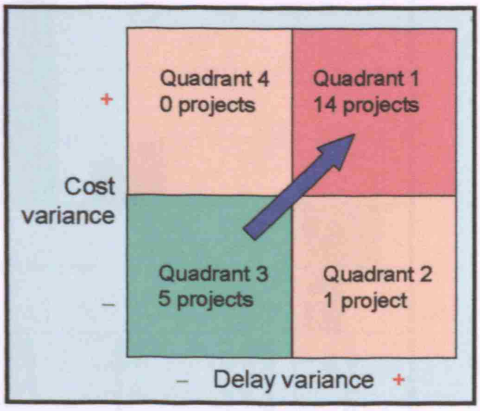

Figure 18 The chart illustrating cost variance against delivery variance. The blue arrow shows the trend with time. Quadrant 1 – projects over cost approval and beyond time approval. Quadrant 2 – projects within cost approval and beyond time approval. Quadrant 3 – projects within cost and time approval. Quadrant 4 – projects over cost approval and within time approval.

All Smart projects start their lifecycles in Quadrant 3. Historically, as projects have progressed through their procurement lifecycles they have migrated from Quadrant 3 mainly to Quadrant 1. Typically, this has been in a pattern characterised by time slippage early in the lifecycle, cost increase in the middle, and further time slippage towards the end. When there is slippage, keeping the supplier's project team working for longer almost inevitably results in a subsequent rise in cost.

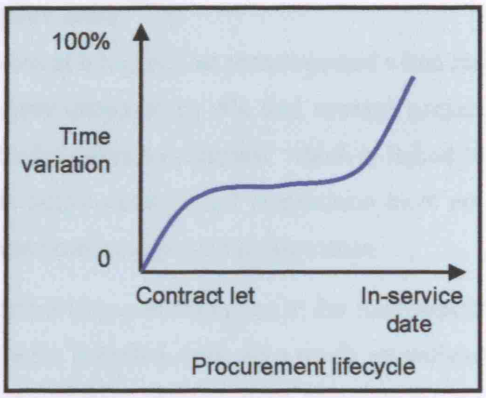

Figure 19 Illustration of historic timescale variation from contract award to ISD.

Whilst historically (pre-2000) the UK has spent about 10% of its equipment procurement budget on collaborative programmes, it is anticipated that in the future this may rise to as much as 40%.[99] However, due to the multi-nation/multi-company involvement, an increase in the number of collaborative programmes will inevitably lengthen rather than reduce overall timescales.

Collaborative projects such as A400M transport aircraft and Beyond Visual Range Air-to-Air Missile have suffered delays and had time risk differentials of only 10 and 11 months respectively. Past experience indicates that aligning national approvals and gaining consensus between the partner nations can cause lengthy delays between Main Gate approval and contract let. The relatively short time-risk differentials in these cases may again reflect optimism in the Main Gate approvals.

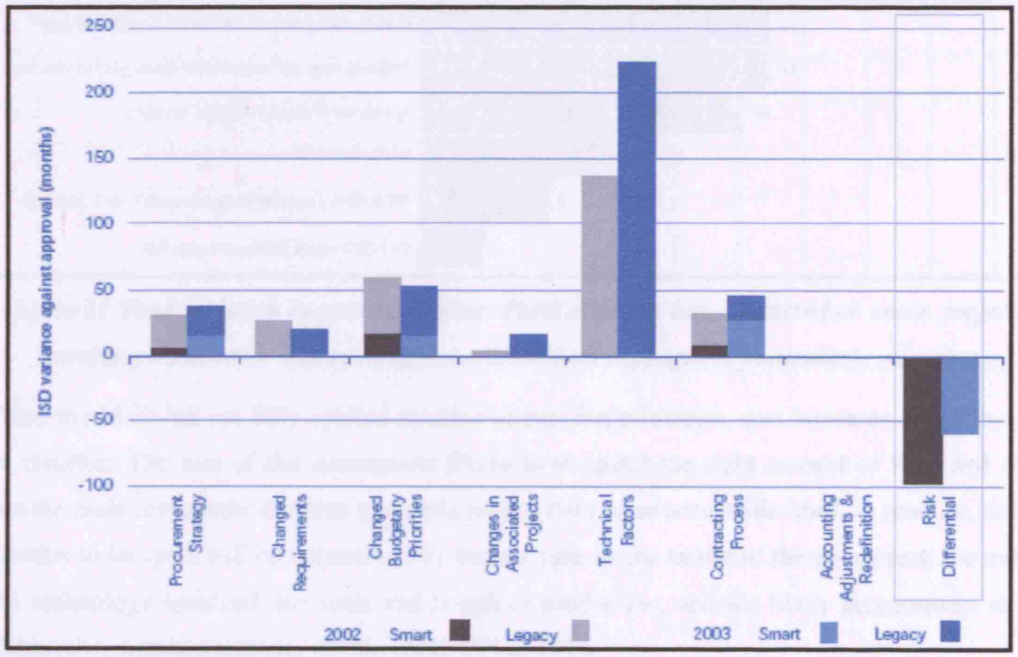

Figure 20 Report Figure 12 Analysis of total time variation by factor in the 02 and 03 Reports[s].

[s] Figures 18-20 are reproduced from the NAO Ministry of Defence Major Projects Report 2003.

4.7 NAO Ministry of Defence Major Projects Report 2004 [100]

MoD expects its top 20 equipment projects to meet KURs but at a higher cost than expected when the projects were approved. In the last year, forecast costs have increased by 4% and average project delays by three months. The cost increase in the 2004 includes interest on capital, which is linked to the average three-month delay on projects. Many projects begun under Smart Acquisition have not consistently applied the principles designed to underpin improvement in project performance.

Many of the difficulties arise from failure to spend sufficient time and resources in the Assessment Phase and failing to provide appropriate mitigation plans for the potential risks. As a result, unrealistic expectations have been set at Main Gate. Projects less than halfway through their procurement are already expected to be delivered later or to cost more than approved. It is of particular concern that the fifteen most recent projects are progressing rapidly towards their 'not to be exceeded' approvals and six have already breached them.

Of the top twenty projects, in performance terms within the previous twelve months only one, the Support Vehicle (Cargo & Cargo and Recovery), has missed its Key User Requirements (2 of them). On the other hand as Figure 21 shows, seven have slipped their in-service timescale by an average of 3.4 months in the last year. In fact, twelve projects show overall slippage of in-service date against the most likely in-service date at approval, and one, Bowman, shown as having made its in-service date, is years late; a new start having been made with a second prime contractor.

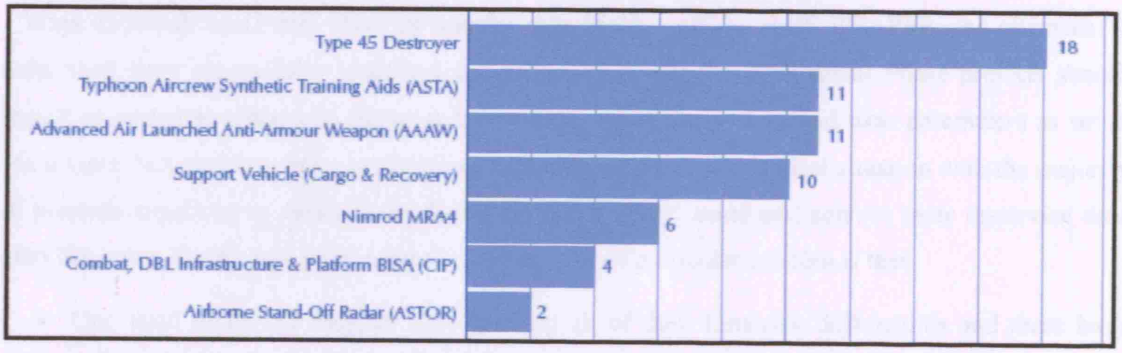

Figure 21 Time variation in-year by project. Further delays have occurred on seven projects, totalling 62 months. The scale of some individual slippages is particularly worrying.

Where the MoD has not fully applied sensible acquisition principles, cost increases and delays have often resulted. The aim of the Assessment Phase is to spend the right amount of time and money before the main investment decision to reduce project risks to an acceptable level. In practice, the right proportion to be spent will be determined by factors such as the nature of the equipment, the maturity of the technology involved, the scale and length of production, and the likely procurement strategy (collaborative, non-competitive, off-the-shelf, PFI or PPP).

On projects that incorporate untested technology, have a high integration risk, long timescales and complex commercial arrangements (often involving international collaboration) the level of

Assessment Phase expenditure has been surprisingly low. On the Typhoon, Astute, and Nimrod projects Assessment Phase spending was less than 1% of the total project cost. Even on more recent high-risk projects such as the Type 45 destroyer, Beyond Visual Range Air-to-Air Missile and A400M, Assessment Phase spending was less than 4%.

Recent difficulties can, in large part, be traced back to not undertaking sufficient work in the Assessment Phase to identify and mitigate risks or to set realistic cost, time and performance parameters for the demonstration and manufacture phases:

- The Typhoon Aircrew Synthetic Training Aids project has been delayed by 11 months in the last year. The delays were due to technical difficulties in integrating sub-systems and to an underestimation by industry of the time needed in the formal acceptance process.
- The Type 45 destroyer has been delayed by 18 months in the last year because of the longer than expected time to set up the correct industrial arrangements and obtain integration data.
- The Beyond Visual Range Air-to-Air Missile suffered an 11-month slippage in the two years up to March 2003 because the time taken to complete the Memorandum of Understanding negotiations with other nations was underestimated.
- 19 months of the delay to the Support Vehicle project are directly attributable to the decision to bypass the Assessment Phase.

Ways in which MoD may share or transfer risks include off-the-shelf, PFI, PPP, and alliances. If risks have been successfully identified and mitigated during the Assessment Phase projects should expect to complete either just above or below their 'most likely' cost and time parameters as set at Main Gate. In practice, project performance is some way short of this ideal situation with the majority of projects expecting to spend more than their 'most likely' costs and achieve their in-service date after the 'most likely' date set at approval. Stated to be of particular concern is that:

- One third of the 15 projects have used up all of their time-risk differentials and three have breached their approvals.
- Five projects not halfway through their procurement lifecycle have used up either their cost-risk or time-risk differentials or both of them.
- Four of the 15 projects have now used up all of their cost-risk differentials and two have breached their approvals. (This is solely a money issue.)

The variation between the forecast differential (50%) for time, and highest acceptable (90%) for time, at Main Gate is reported as the Risk Differential. If risk identification is performed effectively, there should be a similar number of projects delivered within as delivered beyond their most likely forecasts. There should be no projects exceeding their highest, or latest, acceptable parameters.

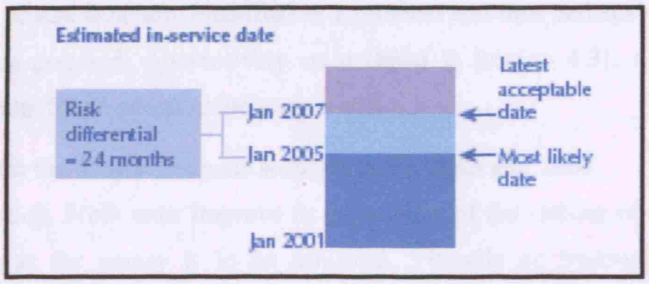

Figure 22 The variation of estimated in-service date depends on the risk differential.

This report highlights several issues. When examining the PCT-effective integration envelope, performance is rarely compromised – in only one project; delivery-timescale slippage is relatively commonplace as shown in Figure 23 (it is often associated with cost overruns); and effective integration is too new to be reported. Increasing expenditure during the Assessment Phase reduces the risk of problems in later phases. Thus there is clearly a 'value' to a well-funded Assessment Phase.

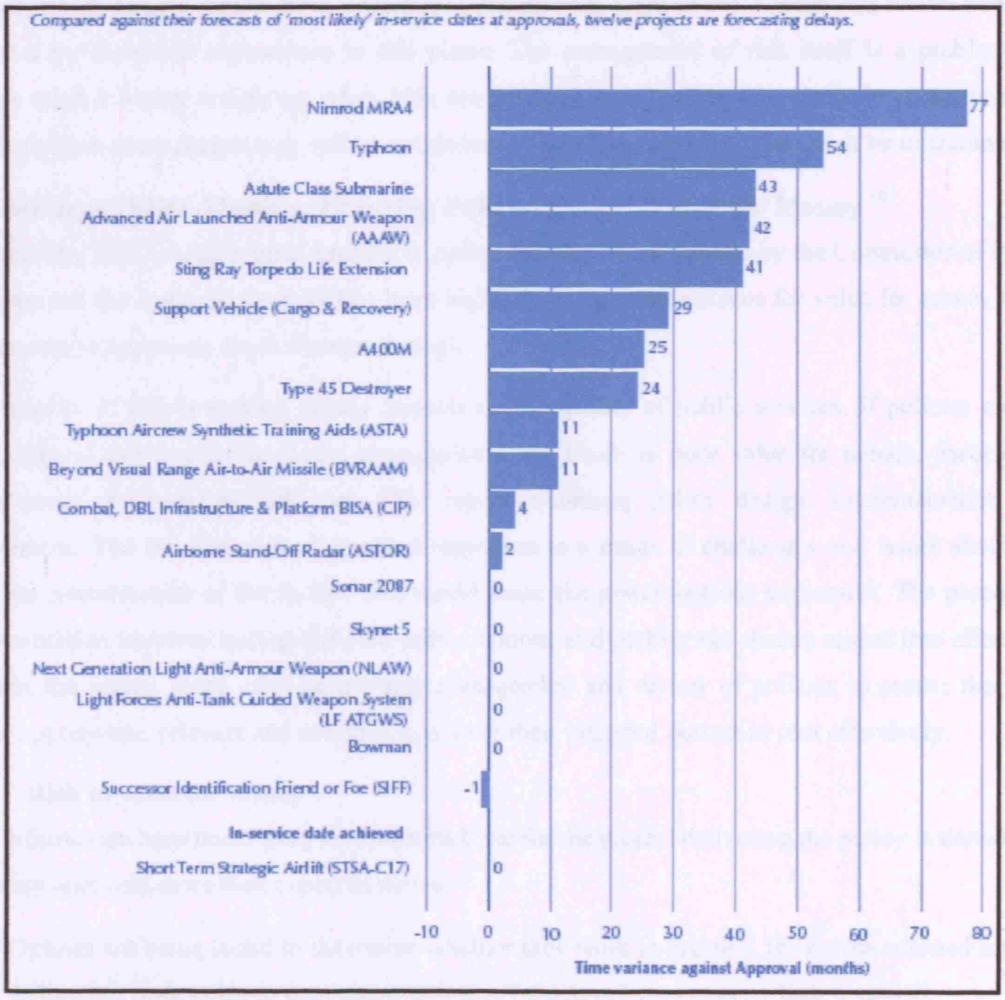

Figure 23 Time variation since approval compared with forecasts of 'most likely' in-service dates at approval; twelve projects are forecasting delays.

The management of risk is clearly identified as a problem and thus perhaps need a higher weighting when bids are being assessed. Alternatively, as outlined in Section 4.31, a financial value can be placed on risk, and this figure added to the project cost.

4.7.1 Comment on the Major Projects Reports 2000, 2003 and 2004

During source selection, MoD must improve its assessment of the realism of the quoted delivery and cost if the best value for money is to be achieved. Virtually no trade-off is occurring between performance, delivery time and cost. Perhaps MoD's rare compromises on performance could be increased in number as trade-offs against the apparent low value it places on delivery (and cost). The impact of the planned increase in the number of collaborative programmes must be accepted. This will inevitably lengthen project timescales and increase the risk of their being delayed.

The aim of the Assessment Phase is to spend the right amount of time and money before the main investment decision to reduce project risks to an acceptable level. Recent difficulties with complex projects, which largely results from undertaking insufficient work in the Assessment Phase, could be mitigated by increased expenditure in this phase. The management of risk itself is a problem and perhaps need a higher weighting when bids are being assessed while the relatively short time-risk differentials on some project may reflect optimism in Main Gate approvals that must be overcome.

4.8 Modern Policy-Making: Ensuring Policies Deliver Value for Money [101]

The report by NAO outlines good practice in policy-making. Many reports by the Committee of Public Accounts and the National Audit Office have highlighted the consequences for value for money when policies and programmes are ill thought through.

The quality of policy-making clearly impacts on the quality of public services. If policies are not well designed and implemented, the consequences can result in poor value for money, particularly where users' expectations not met. This report examines policy design, implementation and maintenance. The development of practical responses to a range of challenges and issues should be based on consideration of the factors that would make the policy options successful. The process of implementation involves testing different policy options and putting the chosen option into effect. To maintain the policy, there must be ongoing management and review of policies to ensure that they remain appropriate, relevant and continue to deliver their intended outcomes cost effectively.

4.8.1 Risk to value for money

If the information base underlying the Business Case for the project delivering the policy is unrealistic, the policy may cost more than expected due to:

- Options not being tested to determine whether they work in practice, the option selected may be difficult or impossible to implement or it may be delayed or cost more than expected.

- What is expected of those responsible for implementing a policy is not assessed and managed, costs may be higher than expected and policy outputs not delivered.
- A long-term view is not taken of how users' needs might evolve over time; changes in conditions might decrease the usefulness of the chosen policy or make it rapidly obsolete.
- A plan for implementation has not been tested and drawn up to cover resources required to implement the policy successfully, it is unlikely that every implementation requirement will be available at the right time, or a viable solution may be delayed or fail because the necessary resources are not available when needed.
- Responsibilities are not allocated clearly to managers for coordinating implementation including specific milestones; the delivery of the policy will be put at risk.
- A policy is not communicated or marketed sufficiently, buy in from key stakeholders may be lacking and outcomes may be reduced as those at whom the policy is directed are not aware of it or resist the policy.
- There are insufficient plans to maintain service delivery in the event of something going wrong, citizens may suffer inconvenience and fail to receive the service intended.
- Good practice is not identified and spread, then resources are not allocated to priorities efficiently and key outcomes are not secured.
- Information and criteria to review, evaluate and measure performance are not built into implementation, the success or otherwise of policies may be unclear.
- Results from review, evaluation and monitoring are not acted on, existing policies may not be implemented and lessons not learned with the result that the quality of public services does not improve or is put at risk.

Four examples of different types of government services are given, of which 'Services which provide Indirect Benefits' includes 'Defence by the armed forces' which provides security to all individuals. In the same category are policing and foreign policy.

4.8.2 Comments

While much of this report deals with the impact of policy rather than source selection on achieving value for money, there are some factors that do impact on the choice of solution. As an example, for the Bowman communication system, MoD was unable to take full account of the effect which the rapid pace of technological change and the corresponding increase in users' expectations would have on demand. Perhaps the most important factor for MoD is to act as an intelligent customer in all its equipment and services acquisitions.

4.9 Modernising Procurement [102]

NAO asks the question '*What is value for money in procurement?*' It suggests that better value for money from procurement can be achieved in many ways and gives a number of examples, of which the following are relevant to evaluating competitive bids and are similar to those stated in Section 4.3:

1. Getting an increased level or quality of service at the same cost.
2. Ensuring that user needs are met but not exceeded.
3. Specifying the purchasing requirement in output terms enabling suppliers to recommend cost-effective and innovative solutions to that need.
4. Optimising the cost of delivering a service or goods over the full life of the contract rather than minimising the initial price.
5. Introducing incentives into the contract to ensure continuous cost and quality improvements throughout the period of the contract.
6. Aggregating transactions to obtain volume discounts.

4.9.1 Comment

The following comments apply to the numbered items above:

1. The core DPA approach to major procurements appears to be reducing cost rather than increasing the level or quality of service.
2. This is an approach taken which may not always give the best value for money in the ever-changing threat scenario of defence. An offer that exceeds the user's stated needs may provide a battle-winning capability and require a reassessment of the requirement for the original capability.
3. This is indeed the lynch pin of Smart Acquisition.
4. This is another key part of Smart Acquisition but is particularly difficult to apply, given the long life of many major defence procurements, the problems of estimating costs far into the future and the MoD financial horizon of ten years.
5. This is the practice of Contracts Branch.
6. Production of defence equipment is often contracted in tranches, to remain within fiscal limits but losing volume discounts. See the comments on this subject in Section 4.2.1 and Figure 14.

4.10 The Procurement Executive Ministry of Defence [103]

Published as long ago as 1987, this brochure includes the statement in its introduction:

'... *it is on obtaining best long term value for money for defence that we lay most stress when buying equipment for the Armed Forces.*'

This is reaffirmed in the chapter on policy, which mentions the open government document *'Value for Money in Defence Equipment Procurement'* published in 1983.

4.11 Securing Value for Money in Defence Procurement [104]

This paper, written by Sir John Bourn, then Comptroller and Auditor General, was published in 1994, before the Smart Procurement initiative. In the introduction, Sir John states:

> *'In the United Kingdom a principal objective of all Government spending is to secure value for money for the taxpayer. However, the definition of what constitutes value for money in defence procurement ... remains intensely political, with some countries committed to maintaining a large domestic defence industry for security reasons and to retaining a foothold in what are seen as key industrial technologies.'*

The document examines procurement policies and the acquisition of defence equipment from abroad. It outlines the then new MoD initiatives and highlights competition as an *'engine of progress and value for money'*. It mentions that analysis of 13,000 competitions showed an average of 6.4 tenders received and a maximum of 200 tenders invited. It points out that several companies are considering the worth of bidding for future defence contracts, and that bidding costs are passed on to the tax payer through higher overheads on future defence contracts. (**Comment**: this suggests MoD should take steps to ensure that fewer bidders are invited and that less tenders are received. This would have the additional benefit of requiring less work by the IPTs in vetting potential bidders and evaluating bids, potentially saving both time and resource costs in MoD.)

Among other recommendations for improvements to the procurement system, it suggests that MoD should *'inform tenderers of the relative importance the procurement authority attaches to different aspects of the requirement and the criteria against which the tenders will be assessed.'* Its conclusions about competition are that it is a very effective way of improving value for money but there are also risks to value for money. Significant are the cost of competition passed back to MoD by industry and the need for care during evaluation, not just to consider the cheapest overall price, but also to place due emphasis on assessing the tenderer's ability to complete the contracted task.

In the section on risk transfer, it notes that value for money is secured by ensuring that payments are only made against contractual performance milestones, which guarantee specific technical standards and demonstrate that practical progress has been achieved.

It states that the application of life-cycle costing principles are widely regarded as enabling greater value for money to be obtained from both equipment acquisition and in service support. It concludes that two main risks to value for money arise, should MoD fails to:

- Take full account of life-cycle costs when procuring new equipment.
- Address reliability and maintainability at an early stage in the procurement cycle.

In-service support is examined for risks to value for money. The use of military personnel in this role can be very expensive, representing bad value for money. However, one of the biggest risks to value for money, when work is contracted out, is validating whether all bids have been prepared on a consistent basis. The conclusions point the way to the Smart Acquisition initiative introduced a few years later.

There is a reminder that MoD's stated policy is to *'procure from abroad where this offers best value for money.'* It mentions that historically, this has often been measured more in political than economic terms. It concludes that security of supply considerations and foreign-currency transactions carry with them several risks to value for money. In purchasing foreign equipment, the cost of customisation for UK MoD needs and the feasibility of applying future upgrade programmes may also impact on value for money.

In dealing with collaborative projects, two risks to value for money are seen. Equipment procured may not be the most cost-effective means of meeting a nation's needs, and nations may not be making the most of opportunities to group their requirements to maximise their purchasing power.

4.11.1 Comment

This paper, written in 1994, highlights many of the improvements that followed with the introduction of Smart Acquisition in 1998 and also emphasises the numerous potential problems that still exist in MoD procurement over a decade later.

4.12 Ministry of Defence Performance Report 2001/2002 [105]

Chapter 10 of this document entitled Equipment Acquisition states that its objective is: '*To acquire equipment effectively and efficiently.*' It quotes its performance measures as:

- Deliver Smart Acquisition savings of £750M over the period 2001/02 to 2003/04.
- Proportion of equipment projects within approvals for performance, time and cost.
- Percentage of assets delivered on schedule.

As far as Performance Assessment is concerned, it is seeking:

- Reductions of some £2 billion to the cost of MoD's planned equipment programme between 1998 and 2008. Further savings identified in the 2001/02 Equipment Plan total over £500M.
- 65% of equipment projects with a value of more than £20M were within approvals at the end of 2001/02, surpassing the target of 60%.
- 93% of assets were delivered on schedule, exceeding the target of 80%.

(**Comment**: This seems to confirm that MoD is concerned with saving money [and avoiding timescale slippages] rather that seeking best value for money.)

It also states that by improving the management of risk, suppliers, through-life planning and technology, the risk of future slippage should be much reduced. (**Comment**: Here, at least, the issue of delivery timescale rather than cost is being addressed.)

4.12.1 Comment

The whole report seems to be obsessed with saving money and fails to mention that the 'goalposts' have been moved on programmes such as Bowman and Nimrod. It only mentions value for money once, and then just in the context of Public Private Partnerships. Furthermore, all the other occurrences of the word value use the word only in the sense of monetary worth.

4.13 Supporting Essay Ten – The Strategic Defence Review [106]

This essay focuses on procurement and industry. It states '*Smart Procurement means faster, cheaper and better.*' In the context of value for money, faster and better impact on value; cheaper deals with the money. It segments '*acquisition processes into three tiers with processes tailored to each; commodity/low risk items; minor projects and major projects (with collaboration as an important sub-set).*' The first and second tiers are excluded from this research. For the third, '*Key characteristics are high unit cost, substantial technical risk and limited sources of supply. A single integrated project team ... able to balance trade-offs between performance, cost and time ...*' IPTs can make trade-offs that impact on value for money. In procedural terms, '*projects should be subject to formal approvals normally twice only; at initiation, and prior to the main investment.*'

Comment: This research focuses on measuring value when the main investment is authorised. While the closer working relationship between MoD and industry should result in MoD obtaining better value for money in its project acquisitions, it is not intended to pursue this particular avenue.

4.13.1 Britain's Defence Industrial Base and Industrial Capabilities

The Government states '*we support a strong UK defence industry which is a strategic part of our industrial base as well as our defence effort.*' showing that it values the UK defence industry. Thus, MoD '*remains committed to securing the best value for money ... with industrial aspects being assessed against a range of defence-based criteria. These include maintaining the ability for industry to support military operations and to regenerate critical equipment stocks, as well as other considerations, such as exports, collaboration and sustaining the future scope for competition.*' **Comment**: It will be important to establish the relative values of these varied criteria.

4.13.2 Comment

This essay was written as Smart Acquisition was introduced but before 'more effectively integrated' was added to 'faster, cheaper, better.' It highlights the key problems of major procurements and emphasises the potential benefits of IPT and a limited number of approvals. It also refers to the value of a UK defence industry; a factor excluded from COEIAs but included in Business Cases.

4.14 Commercial Awareness guide [107]

This guide highlights the key points relating to contracting with industry. While MoD commercial officers place contracts, it suggests that MoD staff involved in acquisition need to understand the relevant commercial issues.

A significant section of the guide deals with the contracting process, including legal aspects, which is not relevant to this research. It highlights the fact that open and fair competition is the basis of MoD acquisition policy, although competition must be used intelligently. It mentions that some requirements are of such complexity that single source is the only reasonable way forward; a decision for the IPT. Emphasis is also placed on partnering to achieve best value for all parties. In addition to covering commercial and contractual aspects of the acquisition process, the guide also discusses acquisition strategies, the tendering process, forms of contract pricing and tender assessment tools.

4.14.1 Comment

It is relevant to consider the value of the form of the contract. First, this should be fair to both parties. Second, it must protect MoD from poor performance by the contractor. Third, it may or may not include 'valuable' clauses such as equipment warranty and continuity of spares availability.

The optimum acquisition strategy is a vital way of improving value for money. MoD tender assessment tools are discussed in detail in Chapter 5.

4.15 Principles of Cost-Effectiveness Analysis [108]

This document considers cost-effectiveness rather than value for money. Its source is close to the top of MoD – DCSA (Scrutiny and Analysis) though it is already well out of date.[t] There is, however, a close correlation between cost-effectiveness and value for money, despite the fact that operational effectiveness is only part, albeit a very important part, of the value of military equipment. Operational effectiveness also depends on factors such as force mix and equipment quantity. Remembering that cost-effectiveness is a comparative measure, the point is made that such assessment becomes trivial if all competing alternatives can be reduced either to the same cost or to the same effectiveness as is demonstrated in Figure 24. (This approach should also hold good for value for money comparisons.)

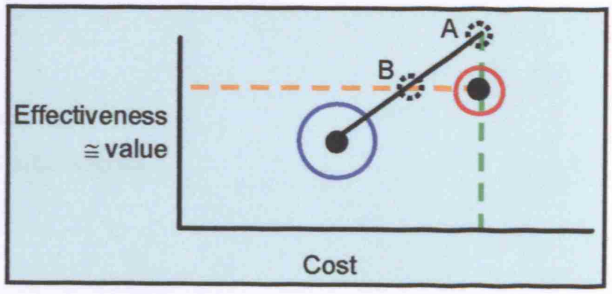

Figure 24 Reducing two competing alternatives to the same cost (A) or the same effectiveness (B).[u]

[t] Mention was made that a revised edition was overdue in 1997.
[u] This figure is not part of the document, but resulted from discussion with the head of the DEG.

The document's Figure 1 is copied as Figure 25. The 'S' shaped curve is illustrative and fairly typical. It represents the maximum technically achievable effectiveness for any given investment.

Two other important factors are that cost-effectiveness is a two-dimensional concept and that it is relative, not absolute.

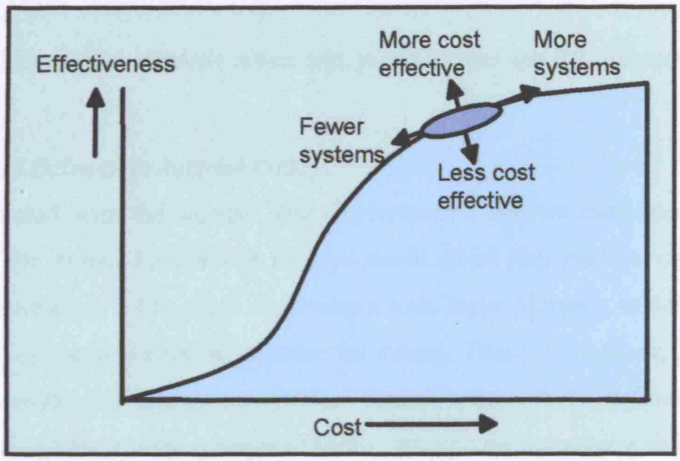

Figure 25 Cost-effectiveness relationships.

The document also discusses COEIAs – Combined operational effectiveness and investment appraisals, used in support of EAC (now replaced by the IAB) dossiers and suggests the use of cost-effectiveness for COEIA comparison purposes only.

The section on uncertainty makes the point that all data, assumptions and judgements used as inputs to analysis are subject to uncertainty from factors such as experimental and sampling errors, environmental variability, modelling simplifications, peacetime versus wartime, the human factor and the general difficulty of projecting in the future.

Two probability distributions are commonly used to describe cost, effectiveness and ISD uncertainties – the triangular distribution and the normal or Gaussian distribution. The main advantage of the former is that the distribution can be skewed; of the latter that it is easy to manipulate using mathematics.

A summary is given of what makes a good cost-effectiveness study:

- Start early.
- Have a clear concept of analysis.
- Use objective information as much as possible.
- Provide a clear audit trail for all data and assumptions.
- Use appropriate and validated models.
- Keep models simple.

4.15.1 Comment

This document has a clear relevance to any study of 'value for money'. When considering cost effectiveness, cost has a clear relationship to money, while effectiveness is a part, but clearly only a part, of what provides value. The information about COIEAs is useful in that it indicates part of MoD's source-selection procedure.

4.16 Defence industrial policy

The following three papers all address the subject of MoD defence acquisitions and the UK defence industrial base.

4.16.1 Ministry of Defence Paper No 5 Defence Industrial Policy [109]

The key conclusions of this document start with the words: '*The Government's defence industrial policy is driven by the need to provide the Armed Forces with the equipment which they require, on time, and at best value for money for the taxpayer.*' The paper deals with a wide range of topics, which are relevant to its title but do not impact on the achievement of value for money. There is, however, a separate section entitled '*Value for money in acquisition.*' This section states that '*defence procurement strategies and investment decisions involve a range of factors which together ensure that the best value for money solution for the armed forces and for the taxpayer can be identified.*' The key factors taken into account in acquisition decisions are:

1. The assessment of the cost, operational effectiveness and delivery timescales.
2. Estimates of whole-life costs and the evaluation of risk.
3. The solution must be affordable.
4. Any impact on the ability to compete future requirements needs careful consideration as competition is used to achieve long-term value for money.
5. Any risk of loosing a very small number of capabilities that for national security reasons should be retained within the UK industrial base.
6. Wider factors taken into account in acquisition decisions
    a. Security of supply.
    b. Certain key technologies.
    c. Future export potential.
    d. Industrial participation.
    e. Factors that may raise legal issues or be affected by MoD's environmental, security, personnel or estates policies.
    f. Desirable industrial capabilities impacting on the UK industrial base for defence reasons or the high value they bring to the industrial economy:
        i. Potential in world markets.
        ii. Extent of generating economic activity of a high value-added.
        iii. Transferability into wider commercial applications outside defence.
        iv. Impact on industrial activity regionally (including the number and quality of UK-based jobs that are created or sustained).

v. Many procurement projects and collaborative ventures are so large in scale and political importance that they have significant implications for foreign and security policy interests.

The section that deals with competition states that it remains the best procurement strategy to deliver value for money for the defence budget. It has also brought other benefits such as helping UK industry in win competitions overseas and encouraging innovation, flexibility, efficient use of resources, and the development of skills and knowledge.

While competition remains the bedrock of procurement policy, it does not mean simply accepting the lowest price tender. Deciding best value for money also involves looking at the performance of the equipment and timeliness of its delivery, the risk involved in achieving the required performance; the sustainability and support costs of the equipment and the wider factors listed above.

Value for money is also a long-term concept, and is not simply assessed discretely for each individual acquisition decision. The aggregate impact of these decisions on project performance and on the industrial and technological base must be considered.

4.16.2 Implementing Industrial Policy – industrial issues and wider national interests in defence acquisition decisions [110]

This guidance shows how and when to consider and analyse industrial issues and wider national interests in defence acquisition. It is underpinned by the key principles of and reflects the government's defence industrial policy described in Para 4.16.1. It also covers in more detail what factors must be considered when assessing bids.

It reminds acquisition staff that the definition of the UK defence industry is based on the economic value that it brings to the UK, by creating employment, technology and intellectual property in this country. UK industry is therefore less about ownership than about considering:

- Whether investment is being undertaken in the UK.
- Whether intellectual property will be created and retained within the UK.
- The number and quality of jobs sustained and created within the UK.
- Whether skills and expertise are utilised or developed within the UK.

If there is value in placing contracts with UK industry, it is clearly essential that those involved in selecting and approving contractors should have a clear understanding of the government's definition of what comprises UK industry.

1 Developing the Business Case

The document suggests that a Business Case (BC) should assess the cost, operational effectiveness and affordability of the options, the principal focus of decision-making done with the COEIA, and in parallel should undertake the following three actions:

a. Gather information on the other factors to be taken into account

- Core project issues (cost, operational effectiveness, whole-life costs, risk). *
- Affordability. *
- Long-term value for money for defence. *
- National security. *
- Security of supply.
- Key technologies.
- Future export potential.
- Industrial participation.
- The wider MoD policy framework.
- Industrial issues.
- Foreign and security policy.

* *Key factors attracting significantly more weight*

The wider issues must be set out so that the approving authorities and ministers are aware of possible consequences of their decision. Bid evaluation criteria should be finalised before an Invitation to Negotiate or Request for Proposals is issued; the evaluation criteria cannot be modified once tenders have been received. **Comment:** This list not only broadens the value beyond faster, cheaper, better and more effectively integrated, but also indicates that the starred items are more highly valued than the others, though how much more highly valued is not explained. There is also the caution about not modifying criteria after the receipt of tenders.

b. Involve other government departments at the earliest opportunity

The views of other government departments (mainly FCO, DTI and HMT) need to be set out objectively within the BC. Their views will impact only on what are referred to in Section 8 as 'other factors' but may conflict with what offers best value for money to MoD.

c. Set out the most cost-effective solution both for the project in isolation and in its wider context

A BC must clearly identify the most cost-effective solution for that project. A separate section should analyse and quantify the wider factors that may impinge on the decision, and highlight the views of other departments. The purpose is to expose all the potentially relevant factors to approving authorities, so that they do not take a decision without being aware of all its potential consequences.

Any quantification of wider issues should be kept separate from the assessment of cost-effectiveness. '*The use of mathematical models to attempt to weave the wider factors into the COEIA is considered unwise as it could mislead the IAB and ministers into thinking that all factors have received adequate consideration.*'

The BC should give an opinion on whether the strength of the wider issues justifies overriding or influencing the cost-effectiveness arguments. However, in most cases the final recommendation in the BC will be the solution which provides best overall value for money (presumably for MoD); it will be the approving authorities that finally decide how the wider factors impact on that recommendation.

2 Long-term value for money for defence

The defence value for money equation is both wider and longer-term than that for individual projects. Any decision, which impacts on the ability to compete future requirements, needs very careful

consideration. Where possible, the following long-term value for money arguments should be quantified in the BC. Will any option affect the ability of MoD to get value for money:

- In the future (e.g. by creating a monopoly supplier)?
- From existing MoD contracts (e.g. by reducing the financial viability of a current supplier or overloading the available capacity)?
- By failing to nurture the development of a UK industrial capability that could contribute in the long-term, (e.g. through the development of UK expertise in a particular field)?

Where there are decisions on a number of projects, which will cumulatively affect the health of one company, or a particular industrial sector, this should be included in the BC.

3 National security

There are a few capabilities which national security places a high priority on retaining within the UK industrial base. The capability must satisfy one or more of the following criteria:

- Security of supply or service assurances even from the UK's closest allies is not sufficient to protect the national interest.
- For national security reasons the UK could/would not procure the capability from overseas.
- It is critical for the UK to retain the ability to develop a future capability, and the UK cannot depend upon any other nation to develop and export that capability to the UK.

Where there is potential for the loss of a national-security industrial capability, action should not automatically be taken which would retain the capability within the UK. Instead, the BC should show:

- How the recommended course of action could result in the loss of a UK industrial capability, even if the procurement being considered is not for that capability.
- How the industrial capability could otherwise be retained onshore.
- The project cost premium associated with retaining the industrial capability within the UK.
- The long-term cost and industrial implications of attempting to retain, or accepting the loss of, this industrial capability.
- The original reason for determining the capability to be a national-security industrial capability, and whether or not there are defence reasons which still justify this definition.

4 Security of supply

Protecting the armed forces' security of supply increases MoD's ability to prioritise the support of equipment in times of conflict even though suppliers may have other demands on their resources. High levels of onshore technology offer greater comfort in terms of the ability to undertake modifications in response to short-term operational demand. However, for capabilities not covered by national security considerations, these advantages are relative, not absolute. An increasing mutual reliance on security of supply is inevitable for all the UK's allies. An IPT will need to assess the level of security of supply by considering:

- Whether any work will be performed overseas and its overall contribution to the acquisition.
- Whether this is covered by an international security of supply agreement.
- The value of MoD's business to the overseas supplier, i.e. such that it would make a special effort to retain MoD's business by prioritising MoD requirements in a time of conflict.
- The industrial capacity of the supplier and whether other governments or companies have significant contracts with the supplier and might compete for supply in times of conflict.
- Whether a supplier is owned or part owned by a foreign government.
- Whether a supplier is bound by security of supply agreements with another government.
- Whether MoD has other means of influencing the supplier, e.g. through a parent company.
- Whether any alternative supplier could offer the same product/service.
- Whether MoD will secure design information or design rights.

5 Key technologies

MoD's science and technology strategy focuses research funds on certain key technologies. The investment gives MoD a particular stake in the effect of decisions on the development of those technologies. Key technologies include those that are militarily essential to retain as well as those with the most future potential for the UK science base. An IPT should highlight in the BC if an acquisition option would help to develop and exploit a key technology or may lead to its loss.

6 Future export potential

Export potential can improve overall cost-effectiveness, both by reducing the unit cost (due to a longer production run) and through the export levy on sales of equipment developed at government expense [v] (also, but not mentioned, by providing equipment support from the supplier for a longer time). Exports can also improve the economic strength of the defence industry. The BC should present an objective assessment of export potential, quantified where possible in terms of the volume and value of potential sales, the employment thus secured, and the impact on individual companies' future order books.

7 Industrial participation

Industrial participation relates to the amount of work to be placed with UK industry on the project being considered and on exports of that equipment. It can encourage technology transfer and secure investment in particular industrial capabilities within the UK industrial base. The BC should assess:

- The quantity and quality of work to be undertaken in the UK.
- Whether the benefits to the UK industrial base will extend beyond the period of the contract.
- The impact on the UK supply chain and any potential improvements in productivity arising from the application of new processes.

[v] It should be noted that this revenue goes to the Treasury, not to MoD.

8 Wider MoD policy framework

Acquisition decisions must be consistent with the wider MoD policy framework. Some acquisition options may give rise to legal issues or be affected by MoD's environmental, security, personnel or estates policies. Each programme will need to consider these issues on a case-by-case basis.

9 Industrial issues

There are industrial capabilities, which it is desirable to retain in the UK industrial base owing to the high value they bring to the industrial economy. Once lost, these capabilities may be difficult to recreate in the future. Project decisions may also have a major impact on individual companies and on regional employment. A proper assessment must be made of the industrial implications throughout the supply chain of the project and address:

- The potential of the capability beyond the project in question, i.e. its potential to be exploited by UK companies in other applications.
- The extent to which it will generate economic activity of a high value-added nature (including attracting inward investment and incorporation in collaborative programmes).
- Its transferability into wider commercial applications outside the defence sector.
- Its impact on industrial activity regionally.
- Its impact on the retention or creation of skills.

Other industrial issues should also be considered, such as the:

- Total amount of work undertaken in the UK and the amount undertaken offshore.
- Number of UK jobs that will be created, sustained or lost.
- Amount of technology or intellectual property that is to be invested in the UK.

10 Foreign and security policy

Some projects are so large and politically important that they have significant implications for foreign and security policy interests. The nature of the defence industrial base can also affect the UK's ability to participate in and influence international collaboration. Advice should be sought on potential project options for:

- UK participation in defence industrial cooperation, including collaborative programmes, to a degree that provides significant influence over programme management and requirement/ technical specifications.
- Strengthening long-term security partnerships with allies.
- Encouraging other nations to join programmes to address capability shortfalls.
- Receiving technology at the highest level.
- Having a more influential voice in international discussions on the way forward on arms control and international security architecture.

An assessment should be made whether any project option could involve dealing with or using equipment or components from countries, which might fall foul of the consolidated export criteria:

- Countries or companies that are based in politically-sensitive regions of the world.
- Countries that are involved in regional conflicts.
- Countries subject to UK or international political or trade sanctions.

4.16.3 Maintenance of the Defence Industrial Base [111]

IPT Business Cases should cover the effect on the defence industrial base. [112] A UK defence industrial capability is '*A skill, process, technology or plant residing in a UK-based or partly UK-owned company needed to design, develop, produce, integrate, repair or maintain military equipment used by the UK Armed Forces to fulfil their missions, and on which the UK government could reasonably expect to rely during a period of heightened tension, crisis or war.*'

Detailed examinations of the defence industrial implications of alternative procurement solutions should recognise the importance of maintaining an ability for UK industry to support military operations and to regenerate critical equipment stocks in crisis and war. The procurement should be assessed in the light of its impact on the UK's ability to continue in the future to:

1. Influence future collaborative procurement programmes and provide a significant industrial contribution to those programmes in the medium and longer term.
2. Minimise cost/operational penalties for in-service support of existing or future systems.
3. Retain an ability to meet unique national commitments and maintain identified critical technologies.
4. Meet MoD requirements through competition.
5. Avoid significant shifts in the balance of defence trade.
6. Achieve defence export sales and sustain overseas in-service support.

4.16.4 Comment

The first paper outlines MoD's industrial policy and the factors it considers under this heading. These are discussed further in Section 8.1.4. These factors are excluded from COEIAs but included in Business Cases. However, no mention is made of how to weight the various factors or how to measure value. It also intriguingly wants to ensure the best value for money solution for the armed forces and for the taxpayer. These two objectives do at times result in conflicting acquisition recommendations.

What is clear from the second and third documents is the enormous number of wider issues that need to be considered by an IPT, the detail they have to go into and, it could be argued, the difficulty they will find in quantifying this information and summarising it in the BC. The statement that '*key factors attracting significantly more weight*' is mentioned but no advice is given on how much more weight. In addition, some factors affect defence value for money, while others only impact on national value

for money. The whole range of industrial issues is difficult to address yet may be of significant importance in the aim of achieving of value for money.

4.17 Defence Select Committee Sixth Report [113]

This is a wide-ranging report, concentrating or two major issues; Smart Acquisition and Defence Industrial Policy. Much of it is not germane to this research, but under the heading *The Defence Industrial Policy – Progress in implementing the Defence Industrial Policy*, Paragraph 107 states that in several areas further progress is needed in implementing the Defence Industrial Policy or there are other concerns relating to the policy. These include:

1. The need to develop an industrial strategy.
2. The need to implement the policy through the procurement process.
3. Consolidation in the UK defence industry.
4. Issues relating to open markets and access to technology.
5. Relations between MoD and industry.

It is thus clear from item 2 above that at present (2004) the acquisition process requires changes to implement the Defence Industrial Policy; this also entailing the development of a Defence Industrial Strategy. These changes will reflect in the measurement of the value of what is being acquired.

Min DP has stated that '*we (MoD) need to further develop and state what technologies and industrial capabilities are of the greatest importance to us in maintaining existing capabilities, and which ones we expect to require in the long term*'; in effect, what technologies and industrial capabilities does MoD value.

Under the heading 'Implementing the Defence Industrial Policy through the procurement process', Paragraph 116 stated that '*a common concern relayed to us was that the wider factors to be taken into account in acquisition decisions ... tended to be considered only at a very late stage in the procurement process*' and the policy is '*absolutely not going to make progress until people implement it through the procurement process.*' Min DP has acknowledged that this was a legitimate concern: '*I think there has been a tendency for it to be considered at a late stage. I think on occasions it is the sort of thing that has been left, as it were, to ministers to consider when the advice comes up to them from officials ... I do not think it should just be left to ministers at the end to consider these wider issues, I think they should be part and parcel of procurement processes from the start*'.

This section concludes with the statement that the Select Committee '*are concerned that the wider factors to be taken into account in procurement decisions are still often being considered at a late stage in the process. We expect DPA to ensure that additional guidance or training is provided to its staff to address this issue.*'

4.17.1 Comment

It is apparent from this document that MoD still needs to undertake work to develop and state what technologies and industrial capabilities are of the greatest importance now and are likely to be in the future. This implies that IPTs cannot know all the present industrial issues that should be included in the BC. Furthermore, the fact that consideration of industrial issues is later carried out by ministers suggests that few if any IAB meetings are considering these issues when assessing bids. The use of suitable tools to combine the wider factors found in Business Cases would certainly make it easier to measure accurately the relative value of competing offerings where industrial issues require consideration.

4.18 Summary of UK government literature

It is clear that MoD is seeking best value for money in its acquisitions and that this policy applies to operational defence equipments as to all other procurements. It is also apparent from the literature search that while there are methods of comparing value, as is done in COIEAs, there is no actual means of measuring value as, for example, when comparing two bids; one that is more expensive and offering better value that another that provides less value but is cheaper.[w] This is shown in the two yellow squares of Figure 26.

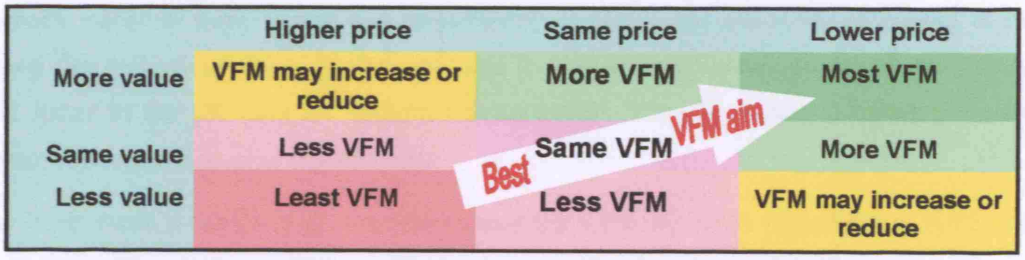

Figure 26 Nine possible outcomes when considering relative value for money (VFM).

To decide whether value for money is increased or decreased in these two cases, it is necessary not only to measure relative value, but also to relate it to money. This is discussed further in Section 8.

From a review of the literature, [x] the following important points appear:

1. The inertia in MoD causes a significant time delay in the implementation of new processes and instructions. The addition of 'effectively integrated' to have equal weight with performance, cost and time, has yet to reach all those involved in acquisition.
2. The management of risk is a still a problem for MoD. It must improve its assessment of the realism of quoted delivery and cost and avoid optimism bias if the best value for money is to be achieved. Increased expenditure in the Assessment Phase significantly reduces major projects risks and the mandated use of SIBET could reduce contractor risks.

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[w] Unless the value of the cheaper offering can be increased to match the value of the more expensive offering and its price proportionally increased.

[x] Details of the MoD Acquisition Management system are covered in Section 7.3.

3. Trade off between performance, delivery time, cost and effective integration needs to be improved. The increase in the number of collaborative programmes will inevitably lengthen project timescales and increase the risk of their being delayed.
4. MoD should:
   a. Develop and state the technologies and industrial capabilities it needs and will need. These industrial factors must not be ignored by the IAB when measuring the relative value of competing bids where these issues are involved.
   b. Take full account of the effect of the rapid pace of technological change and the corresponding increase in user expectations.
5. Equipment manufacture that is split into a number of tranches may provide an affordable solution but is rarely best value for money.
6. Alternatives and options should be considered even if outside the scope of the original call for bids.
7. The approval procedure for the largest equipment project should include the fact that some sensitive major projects are referred to the Cabinet for a decision.

4.19 Defence Procurement, the Equipment Buying Process [114]

This book examines time, money and performance as well as the avoidance or control of risk. It suggests that technology drives performance and that, as a result, in the late twentieth century, the armed forces in the UK have an 'embarass de richesses'. What is needed, the book postulates, is adequate performance at an acceptable cost.

The book deals at length with competition and the Cardinal Points Specification (CPS) system introduced for Royal Navy off-the-shelf procurements. The key facet of CPS is that rather than a complete specification for what is required, only the cardinal points are specified, so that a number of off-the-shelf solutions may meet the requirements of the CPS. Thus it may be seen as a halfway house towards today's capability statements.

It suggests that responsibility should be shared between the service user, the procurement agency and the supply industry. A main theme is the use of COTS for all but very expensive/secure projects.

Reviewing the history of defence procurement, it points out that post World War II, research and development was carried out in MoD research establishments while industry was responsible for production. By 1970 this system had been replaced and one company was the chosen instrument for each key area of defence procurement.

The book then examines defence management in some detail and considers what are the essential issues. It then examines the UK defence industry, how it has changed and how it may alter in the future. It spends considerable time examining the specialised problems of software procurement, concentrating on Royal Navy examples and highlighting the difficulties imposed by a fast evolving

technology. There is a chapter that provides an industry perspective and highlights the radical changes brought about by the move from Downey procedures and cost-plus contracts to the era of competition and in particular CPS. The book ends by speculating about future trends.

4.19.1 Comment

While this was the first book to discuss the complex process of procuring defence equipment, it was written in a different era; in the late 1980s before the end of the Cold War. It is interesting to note that this book only mentions value and value for money once in its first nineteen pages and that value is not found in its index. The volume provides a useful insight into the evolvement of CPS that inexorably led to today's capability requirements.

4.20 On subjectively optimum selection among multi-attribute alternatives [115]

The author notes that the subtle weighing and combining of the factors required for subjective decisions can only be accomplished by the mysterious intuitive deliberations of the human brain. However, difficulty arises when decision-makers attempt to take into account and combine all sub-decisions simultaneously to re-aggregate them to make an absolute judgment of the overall decision. This integration of the many one-dimensional sub-decisions is performed much better by a computer and should be left for it. If an individual chooses not to use a computer for joining the sub-elements but chooses to integrate them mentally, the more that person will rely on intuition to make the final integrated decision, which will always play some role in decision-making. Integration tends to shrink the distance between the two distributions. So, breaking a complex issue into smaller, less complex interrelated variables increases the chance of increasing the distance between the two distributions.

4.20.1 Comment

What is of interest here is the way in which it maps onto the AMS warning against the use of mathematical models to attempt to weave the wider factors into COEIAs. Instead these wider factors are found in the Business Cases but not aggregated by computer. Thus Shepard, over two decades ago, suggests that when making decisions, the IAB would be faced with a degree of reliance on intuition.

4.21 The Bases of Social Behaviour [116]

Peter Kelvin, UCL Department of Psychology, looks at value philosophically even questioning to what the word refers. Comparing an order of value with one of size, arranging different objects by size is straightforward. Any dispute is settled by measurement. To assess the morality of several courses of action involves 'value judgments' the bases of which are not self-evident. One approach assumes certain 'absolute values' – generosity is always 'good'. Given criteria for assessing generosity, these can be applied to find how well they measure up. In this case an object's value will appear inherent in the properties of the object itself. Alternatively values may be subjective – individuals attribute value to objects on the basis of their feelings. In this case an object's value will be determined by an individual's reactions towards it, not by its inherent properties.

Some values are absolute but many are subjective, with no clear distinction between 'absolute' and 'subjective' values. A more natural contrast is between 'subjective' and 'objective'; 'absolute' and 'relative'. Relative values refer to a situation in which the value of an object or course of action depends on its context, particularly an individual's culture. The concept of relative values describes a special class of subjective values. An individual is normally part of a group/culture with its values. Criteria for approving of an object or course of action and disapproving of others often rest on beliefs about the attitudes of others in the group. Subjective and relative values have the common characteristic that value is attributed to objects not inherent in them. They differ in that subjective values are the reaction of the individual, while relative values are the reaction modified, influenced or conditioned by culture.

Whether values are absolute or relative is an act of faith. If absolute values lie in the properties of the objects judged, then any order in terms of values is a function of these properties irrespective of the views of any individual or group. This is like religion – certain things or actions are inherently good or bad – and this is the will of God. (Some MoD employees are 'died-in-the-wool' and unwilling to change their views.[117]) The relativist regards values as a reflection of how people think and feel in a particular culture. Man's systems of value are man-made[y] reflecting feelings and can be changed. Any decision on whether values are absolute or relative also affects the concept of an order of value. In one case the order is given and permanent, in the other man-made and open to change.

Any decision is essentially an act of faith and thus a value judgment. Different people and cultures seem to have different values. The relativistic approach is therefore more satisfactory. A valued object, act or condition is one that is a source of satisfaction, whether simple and superficial or complex and profound. An individual places various objects in order of value based on the degree of satisfaction derived from them. Often people have different views. Rational consumers buy the most satisfying products before those offering less satisfaction. This implies an ability to quantify and compare relative benefits of various choices. An order of value may be deemed an order of priorities of those in a social environment. Order in a social environment is a function of power vested in institutions, or individuals, by virtue of their position on the social structure.

4.21.1 Comment

This section of the book raises four important points. First, relative value appears likely to be used in making acquisition decisions. Second, different parts of MoD have different cultures. Consider the diversities in this area between those in EC, DPA and DLO, not to mention between MoD serving officers, scientific civil servants, administrative civil servants and politicians. Third is the question of order of value and this is a key fundamental that this research addresses. The final point is the issue of power, which can apply both to MoD departments and to the individuals involved in deciding what is likely to offer best value for money. It is not only the order of value that any individuals place on their

[y] When this book was written in 1970, there was no political correctness; thus the use of the word 'man.'

assessment when making a recommendation for a particular procurement decision, but also the order of value of the views of the various members of a decision-making group.

4.22 Value-focused Thinking [118]

This seminal book describes an approach to decision-making. It suggests that values, goals and objectives are needed before seeking decision opportunities that help to reach those goals. It provides some thought-provoking information about decision-making. Some of the key points it makes are:

1. Value is more fundamental to decision-making than choosing between alternatives.
2. Deciding the objective helps to generate alternatives.
3. There is a difference between value-focused thinking and alternative-focused thinking. In the former, specifying values is the step before creating alternatives. In the latter, identifying alternatives comes before specifying values.
4. In deciding between alternatives, easy-to-measure hard data is usually preferred to soft data e.g. quality.
5. Values of decision-makers are made explicit with objectives. Hence, the set of objectives developed for a decision frame is absolutely critical and qualitatively states all that is of concern in the decision context. The objectives also provide the foundation for any quantitative modelling or analysis.

(Many MoD requirements are difficult to quantify, for example ease of operation.) Keeney suggests that the term 'attribute' is employed and likens it to 'measure of effectiveness', (a term that is part of the COEIA.) The advantage of both terms is that, in principle, they allow the achievement of objectives to be measured. Three types of attribute are discussed: [z]

- Natural – For example, if the objective is to minimise delivery time, then the attribute is delivery time in months.
- Constructed – Where it is impossible to find a natural attribute, for example in the case of the protection provided by tank armour,[aa] it may be possible to construct a table to enable the attribute to be measured.

Attribute level	Description of attribute
5	No penetration by any enemy weapons.* Physical discomfort when hit.
4	No penetration by any enemy weapons. Some injuries when hit.
3	Occasional penetration by largest calibre enemy weapons.
2	Regular penetration by largest calibre enemy weapons.
1	Occasional penetration by all enemy weapons. * *Anti tanks guns & missiles*

[z] The non-military examples in the book have been converted to ones more relevant to the military environment.
[aa] Again, the non-military examples quoted have been converted to ones appropriate to military procurement.

- Proxy – A typical objective of a weapon system might be to reduce collateral damage. A proxy attribute would be to measure the weapon's CEP (Circular Error Probable); essentially the mean point within a radius of a circle where 50% of the weapons will fall. However, this single proxy attribute is clearly insufficient and a second one, radius of damage is needed, and this one will inevitably have to be a constructed attribute.

The book continues by examining how to quantify objectives with a value model and considers the situation where there is a set of objectives. The value model assigns a number to each consequence $x = (x_1, \ldots, x_n)$ where x_1 is the level of the attribute X_1, measuring objective O_1, such that the numbers assigned both indicate the relative desirability of the consequences and can be used to derive preferences for the alternatives. It also considers value trade-offs. This is also what is proposed in Appraisal and Evaluation in Central Government described in Section 4.1.

The chapter on creating objectives for multiple (as opposed to single) decision-makers is relevant both to IPTs and the IAB, and refers to all involved as stakeholders. The importance of eliciting the objectives of all the shareholders, how they should be selected, the need for their involvement early in the process and how to combine objectives hierarchies are highlighted. (There is discussion on stakeholders for major MoD projects in Section 8.6.2.)

The book finishes by giving a reminder that an understanding of values inherent in a decision situation can provide insights into decision-making. This is particularly relevant to IPTLs and the IAB.

4.22.1 Comment

MoD's capability rather than solution-based approach matches well with the central thesis of this book to consider value rather than chose between alternatives. A capability statement should set the objectives clearly, thus meeting the requirement for value-focused thinking. The objectives provide the foundation for the analysis of Operational Effectiveness as part of the COEIA. However, by the time a decision has to be made between competing tender submissions, it may simply be a choice between alternatives, but innovative approaches are encouraged and should be judged on whether the idea has the potential to provide better value for money. The use of attributes is already employed by MoD in measuring the operational effectiveness of alternatives.

4.23 Value: Its measurement, design and management [119]

Much of this book concentrates on how industry should approach the development of 'value for money' products and covers such topics as value engineering, quality function deployment and customer-orientated product concepting. Its early chapters do discuss the nature of value and its measurement. Well referenced, the book deals in a clear manner with a number of useful and relevant concepts summarised below.

4.23.1 Individual value

A person who has a need will see value in a product [bb] that can meet that need, or help to meet it. The size of the value depends on how far it can meet the needs of the person. Benefits are stated as those aspects of a product that meet needs.

To establish individual value of any product, a set of criteria must be selected and then a scoring system established for each criterion. The score will need to be weighted for each criterion depending on the value base of the particular individual.

4.23.2 Value and worth

Worth is used here to describe the worth of a product to an individual. Value is used to describe an average worth that a group of people ascribes to a product.

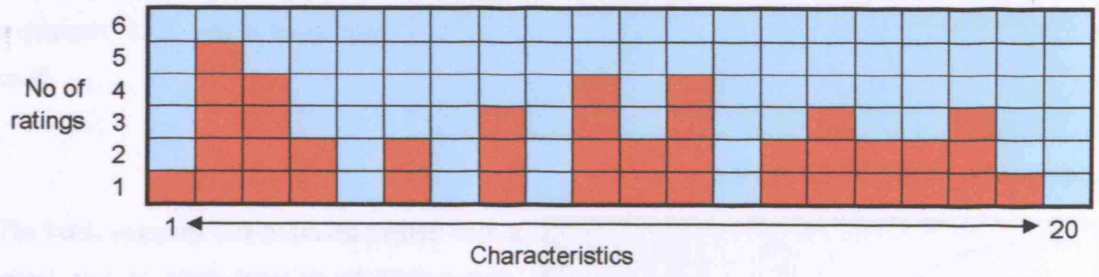
$$\text{value} = \frac{\Sigma\ (\text{worth } 1 + \text{worth } 2 + \ldots \text{ worth n})}{n}$$

4.23.3 Changing value with time

A useful example of how value changes with time can be demonstrated by the value of electric light. Artificial light is of low value during daytime, except in buildings with inadequate windows. Such light is also of no value to people who are asleep at night.[cc] Thus the value of electric light is seen to vary both with time and location.

4.23.4 Group value

Life becomes much more complex when considering meeting the needs of more than one person. Thus for any product the group needs first to decide which are the important characteristics. They then need to rate these characteristics in order of importance by, for example, giving a total of 100 points spread across all the characteristics. A mean value can be calculated, but it is also useful to show how may people scored what points for each characteristics in a graph as shown in the table below. The Delphi method[dd] may be used to improve the reliability of such ratings.



[bb] Product here means product or service.

[cc] Although not mentioned, artificial light is also of no direct use to blind people.

[dd] A technique to reach a group position, it comprises a series of repeated interrogations, usually by questionnaire, of a group whose opinions are sort. After initial individual interrogation, subsequent interviews include information, usually anonymous, from the preceding round. Individuals are encouraged to reconsider and, if appropriate, change previous replies in light of other group members' responses. After 2 or 3 rounds, averaging determines the group position. http://pespmc1.vub.ac.be/asc/Delphi_metho.html accessed 6 Aug 2005.

Once the importance of the various criteria has been determined, reflecting the customer's needs, the importance of each component or sub-system of the product can be ascertained. (**Comment:** The difficulty of this approach is that, even for a simple product that meets a military requirement, such as the candle found in aircrew survival packs, a diagram showing cause and effect between each component of the candle and each customer need is really quite complex. Thus, for a complex product, such as an aircraft, the technique is really only feasible at the major sub-system level – airframe, engines, controls, avionics, fuel system.) The construction of a system dynamic model as shown in the table below will definitely help in this process.

Criteria	Weight	Component 1	Component 2	Component n
Criterion 1	w^1	$a^1 \times I^1$	$a^2 \times I^2$	$a^n \times I^n$
Criterion 2	w^2	$a^1 \times I^1$	$a^2 \times I^2$	$a^n \times I^n$
Criterion n	w^n	$a^1 \times I^1$	$a^2 \times I^2$	$a^n \times I^n$
Total importance	$\Sigma (w^1 + ... w^n) = 1$	$\Sigma (a^1 \times I^1)$	$\Sigma (a^2 \times I^2)$	$\Sigma (a^n \times I^n)$
Total cost		$£^1$	$£^2$	$£^n$
Value index		$\Sigma (a^1 \times I^1)/£^1$	$\Sigma (a^2 \times I^2)/£^2$	$\Sigma (a^n \times I^n)/£^n$

The value index = % importance/% cost (for each component).

4.23.5 Value graph

A value graph plots importance against cost for the various components of a product, in this case indicating the cost target, importance target and value target. In the case of the example in Figure 27, three components, 1, 2, and n have been plotted.

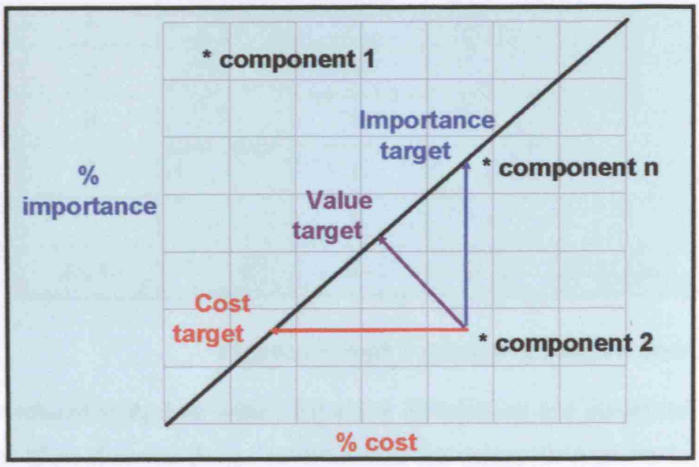


Figure 27 A typical value graph.

The book suggests that products plotted with a vertical axis as some measure of performance, such as efficiency, tend to follow an 'S' curve over time, as shown in Figure 28.

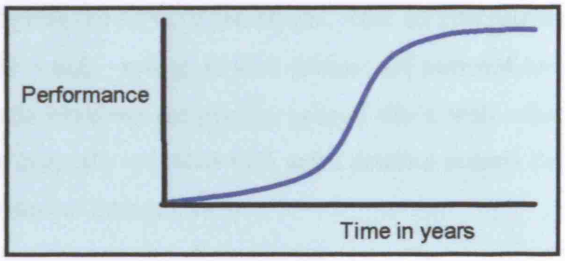


Figure 28 The way a value chart turns out in practice.

4.23.6 Weighting and combining factors

The subtle weighing and combining of the factors required for subjective decisions can only be accomplished by intuitive deliberations of the human brain. However, difficulty arises when a decision-maker attempts to take into account and combine all of the sub-decisions simultaneously, to re-aggregate them to make an absolute judgment of the overall decision. A computer better performs this integration of the many one-dimensional sub-decisions. If the individual chooses not to use a computer [ee] for joining sub-elements but decides mentally to integrate them, then the more the person will rely on intuition to make the final integrated decision.

4.23.7 Concept selection

Stewart Pugh [ff] has devised a simple non-numeric comparison process for evaluating design concepts, based on the premise that engineers/designers are often blinded by preference for their favourite approaches. Strong adherence to a concept makes it difficult to select alternatives. When a poor concept is chosen from a set of design candidates, the result suffers from 'conceptual weakness.' (Could this also be true of MoD selection teams?) Pugh has developed a progressive and disciplined concept formulation and evaluation process to minimize conceptual weakness. A matrix is generated that arrays sketches of alternative design approaches against a set of product criteria. Figure 29 illustrates his concept selection matrix.

	Concept sketches				
Criteria	1 	2 	3 	4 	5 
A	+	Reference	+	–	S
B	+		+	–	+
C	S		+	S	–
D	S		+	–	–
E	–		S	+	S
Totals	2+, 1–		4+	1+, 3–	1+, 2–

Figure 29 Pugh's concept selection matrix.

One concept is selected as a *datum* reference against which the other alternatives are compared. Often this datum is an existing product. If an alternate design is better than the datum for a particular criterion, it is rated as a plus (+), if worse, as a minus (–). When doubt exists about the advantage or disadvantage of an alternative, it is given an S to signify the same as the datum. After all alternatives have been evaluated and the matrix is complete, the + and – ratings in each column are summed and used to identify the best concept. Pugh recommends repeating the process several times with other reference data as a consistency check. The process is usually repeated with more detailed criteria for the few strong concepts that emerge from the first round of ratings.

[ee] This was written in 1991, when computer use was still relatively uncommon.
[ff] Professor of Design Engineering at the Loughborough University of Technology.

4.23.8 Musts and wants

A 'must' is a criterion that, if not satisfied, means the product or operational function will not perform to the user specification if at all. A 'must' is either satisfied or is not. There is no partial fulfilment. 'Musts' usually specify some minimum level of performance or fulfilment below which the user will not accept the product. On the other hand, a 'want' is a desired additional feature, a 'nice to have' criterion, but the product will perform satisfactorily without it.

4.23.9 Weighted scale evaluation

It is essential to define and quantify a set of decision criteria. Having identified the criteria, the team then quantifies the relative importance of each. Better accuracy is achieved if the team works as a group to allocate marks against each criterion, rather than summing the marks allocated by each individual in isolation.

4.23.10 Value management

Decision-makers often face complex issues and are reluctant to deal with complexity in a structured systematic way. In considering the management of value, Figure 30 indicates the overall basic elements found when assessing value; the issue itself, the team involved and the methodology they employ.

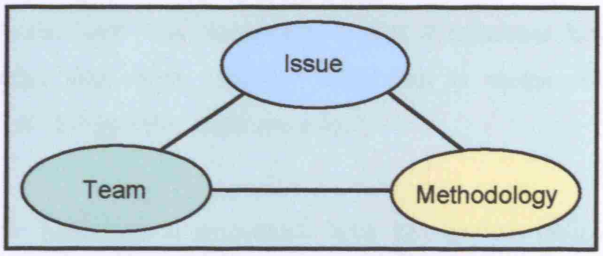


Figure 30 The three basic elements impacting on value.

4.23.11 Comment

The statement that *'Worth ... describe(s) the worth of a product to an individual. Value ... an average worth that a group of people ascribes to a product'* may only be true if the group of people rate the worth to every person as equal. This is clearly not necessarily the case for MoD. Once again, as in Section 4.20, this book suggests that a computer better performs the integration of many one-dimensional sub-decisions. If an individual does not use a computer but decides mentally to integrate sub-elements, then the more the person will rely on intuition to make the final integrated decision. Pugh's concept selection process should be equally applicable to acquisition decisions in which case the reference could be the original capability statement or one of the bids.

4.24 Competing on Value [120]

In the Foreword, Ian Ryder,[88] states that *'... business processes governing all company operations have to be aligned to deliver customer value... '* This book concentrates on the topic of Unique Organisation Value Proposition as a replacement for Unique Selling Proposition. Most of the text deals with the generation and impact of a Unique Organisation Value Proposition for commercial organisations.

[88] Hewlett Packard Director Brand Management and Communication.

Despite this, there are some valuable and relevant observations. '*The recession of the 1990s has probably encouraged customers to take a hard look at the value of all their purchases.*' This certainly reflects current government and MoD policy. '*When faced with a purchase, ... the industrial* [hh] *buyer's problem is risk. ... Psychological risk is associated with how customers think others will perceive them as a result of their purchase choice. This psychological risk is thought to be a part of every purchase decision.*' At first glance, this might be thought of as referring to 'an individual's fashion statement', but further consideration suggests that every MoD purchase of operational military equipment must, to an extent, be influenced by how potential enemies will view it.

In considering making a choice between similar offerings: '*Competition has driven quality standards to the point where it is rare to find a great disparity in manufacturing standards for similar products.*' This is probably as true for military equipment as for any other, but does not address design quality. A key reference from this book is '*Marketing planning which supports Unique Organisation Value Proposition architecture has to address what customer value is.*'

The penultimate chapter – *Measuring the value gap* – is interesting in that it examines how commercial suppliers can try to assess whether they offer customer value that is unique and identifiable. This is implemented by using a series of diagnostic questionnaires.

4.24.1 Comment

MoD carefully examines the value of all their purchases in accordance with government policy. Although psychological risk might not seem an issue for MoD, considerations of deterrence value must affect the purchase of any operational equipment. The quality of manufacture from all defence contractors is similar although standards of design inevitably vary from company to company.

4.25 MCDM in tender evaluation – A South African perspective [121]

This paper, produced by a member of the South African National Defence Force, looks at the acquisition of a number of complex military systems where offers had to cover:

1. The military value of the system.
2. The financing options.
3. Industrial participation.

The paper interestingly examines the evaluation of the bids in terms of the military value of the main equipment. This process had to conform to certain decision-making imperatives, particularly participation by all stakeholders, accountability, transparency and quality of output. The evaluation team came from different disciplinary areas and the process allowed inputs from their different perspectives. It also had to present the data in a visible and dynamic form to facilitate discussions. The final interpretation and presentation of the results had to be credible for acceptance of the conclusions.

[hh] As opposed to consumer.

The process consisted of the five steps shown below and interestingly V•I•S•A (see Section 5.2.1) was used as the decision-making tool.

1. System specification.
2. Development of a value hierarchy.
3. Scoring of alternatives.
4. Evaluation of the results.
5. Recommendation.

A method of prior articulation [122] was used to comply with decision-making criteria, which were categorised either as mandatory of discriminatory. The value hierarchy produced a very large value tree but this was easily divided into sub-trees. V•I•S•A was considered user friendly and the results were easy to view. It was also possible to see the effect on the output of changing scores or weighting. The output of the decision model included a numerical expression of system effectiveness. However, since not all the project teams used the same process, all the results were represented by the following measure:

$$\text{Points per billion Rand}^{ii} = \frac{\text{System effectiveness (0 – 100)}}{\text{Cost (Total program value)}}$$

The number of points/billion Rand was then normalised to represent the relative military value of different alternatives.

Despite numerous difficulties, a wide range of lessons was learned, of which the need to develop a value hierarchy before any request for information/bids is sent out is viewed as crucial and the difficulty of assigning weights to non-redundant criteria is fundamental. The use of multiple criteria decision-making in the evaluation of tenders was viewed positively and the use of a transparent, well-structured process contributed to the quality and acceptability of the outcome.

4.25.1 Comment

This paper suggests that the measurement of the relative value of competing bids is possible and that it is worthwhile considering V•I•S•A as a possible tool. However this evaluation, like a COEIA, it seems to have concentrated on cost effectiveness at the expense of industrial participation.

4.26 US DoD and Best Value Procurement [123]

Best Value Procurement has moved to the forefront of the US government's purchasing procedures. Clear and seemingly uncomplicated in its intent – a focus on awarding contracts to those who offer the greatest number of advantages, the greatest value for money spent rather than on only awarding contracts based on the lowest price – its implementation has been uneven.

[ii] South Africa's currency.

Innovation does not always lead to simplicity. In the case of best value procurement, a wide range of advanced issues has continually arisen since its inception. Whether for a product or service, there are several problem areas, unclear directions, shifting interpretations and growing precedents such as selecting evaluation factors and standards, capability factors, the conduct of past performance evaluations and interpretation of the Federal Acquisition Regulations.

On September 7, 1993 US Vice-President Al Gore submitted to the President his report of the National Performance Review.[124] One recommendation states that the government should *'Recognize other factors besides price, define "best value", and provide regulatory guidance to implement a program for buying on a "best value" basis.'* Two organizations, one federal and one at state level, have gained experience in this area.

The Defense Personnel Support Center began experimenting with 'best value' buying in 1990 with excellent results, showing that over time the number of contracts terminated decreasing by 30% initially, and by 90% ultimately. Only two of the 343 best value buys awarded over the past four years have been terminated for default. What a risk reduction!

Best value briefly means making contract award decisions not just on price but also on factors such as ability to complete the contract successfully on time and at the quality specified. Additionally, an evaluation of past performance provides an important determinant in making the award decision. 'Best value' criteria for evaluating data processing, telecoms and systems integration procurements include:

1. Product quality.
2. Vendor financial stability, past performance and experience with projects of similar scope and complexity.
3. Reliability of vendor's delivery and implementation schedules.
4. Extent of integration and data exchange with existing systems.
5. Warranties, guarantees, and return policy.
6. Operational costs incurred if bid is accepted.

4.26.1 Comment

This paper is of particular interest because:

- It indicates the approach being taken by the world's largest procurer of military equipment.
- Of the six best value criteria stated, only two (product quality, and extent of integration and data exchange with existing systems.) would be found in a COEIA. The remainder occur in the BC.
- The reduction in the risk of contractor default is astonishing.

It appears likely that UK MoD could benefit from this approach to value.

4.27 Best Value Procurement [125]

A single PowerPoint slide suggests the comparison of the following multiple-evaluation criteria against cost to achieve best value for money:

1. Vendor qualification.
2. Past performance.
3. Technical solution.
4. Total cost (Direct and indirect).
5. Risk assessment.

4.27.1 Comment

This listing follows the US model – items 3 and 4 should give the COEIA output. Again there is concern with contractor potential performance (items 1 and 2), with risk as the final factor for consideration. Again it appears likely that UK MoD could benefit from this approach to value?

4.28 Background to Decision Analysis [126]

Decision analysis was developed in the 1960s and 1970s at Harvard, Stanford, MIT, Chicago, Michigan and other major universities. It is generally considered a branch of the engineering discipline of Operations Research, but also has links to economics, mathematics and psychology.

4.28.1 Types of problems addressed by Decision Analysts

Decision analysis practitioners generally work or two broad classes of problems. The first class involves sequential decisions where uncertainties and probabilistic dependencies play a large role. The second class involves one-time decisions where a group of alternatives must be compared on the basis of multiple (and possibly competing) goals and objectives. The primary difficulty of these types of decisions is in creating a 'value model' that allows explicit comparisons between alternatives that differ in many ways. Sequential decisions are modelled using tools called 'decision trees' and 'influence diagrams'. These tools allow decision analysts explicitly to organise the sequence of decisions and the uncertainties related to the decision.

Multi-objective decisions are modelled by creating a 'multi-measure utility function' that allows an alternative's overall desirability to be computed, based on how it performs on a set of evaluation measures. The study of how to analyse multi-objective decisions is called 'multi-attribute utility theory' or MAUT. A decision-analysis tool 'Logical Decisions' is described in Section 5.2.3.

4.28.2 Comment

MoD has recognised the importance and advantages of the use, in bid selection, of decision analysis and offers Multi-attribute Choice Elucidation, adapted from Multi-Criteria Decision Analysis, for option assessment during tender evaluation (see Section 5.3.1).

4.29 Measuring the Customer's Variation in Value [127]

Variation in value is the identifiable difference in perceived benefits from a product or service. To measure this benefit, the product must be shown to correlate with the customer's requirement. Occasionally, variation in value is present when the difference in a perceived benefit exists, but is not

identifiable. However, without any identification of the benefit, variation in value cannot be measured. Examples of identifiable values include durability, prestige, customer service, price sensitivity, generic equivalent and cutting edge. The article explores three factors that must be incorporated when measuring variation in value: it is perpetual, systematic and must continuously determine the current measurement of success.

Organisations do not all value a product identically and rarely is value the same throughout its lifetime. Most groups consist of smaller behavioural segments with different values for the product. Usually, these segments respond differently to the product, depending upon its benefits. The segments are often too small for the product to reflect a behavioural value by itself. As conditions constantly change, so does the value. Thus, measuring value is perpetual and specific. Besides, the frequency with which it changes depends upon the benefit of the product.

4.29.1 Comment

This article highlights the following two points that are relevant to MoD in its value assessments. Value changes with time and it varies within different parts of an organisation.

4.30 Winning Major Business [128]

This book looks at how large organisations can supply major solutions that win customers. Under the heading *'Customer* (in this case MoD) *sources of value'* there is undoubtedly a difference in concept between the words 'worth' and 'value'. 'Worth' is generally a qualitative word, used in the sense of 'this benefit is worth a lot.' 'Value' is a more quantitative, best used in the sense of 'We need to measure the value of these features to the customer.'

Benefits, such as those that differentiate one project, programme or major product from another, are critical and well recognised as valuable. They are, however, one step removed from the four fundamental sources of value:

1. Cost/capital reduction.
2. Risk reduction.
3. Revenue increase. (Not relevant in MoD's case)
4. Individual gain.

For maximum impact, benefits need translation into value terms. The sources of value for institutional purchases are internally-generated or externally-influenced ones. The internal sources distil down to just four key elements, each of which may be split.

Customer internal sources of value	
Cost reduction: Direct costs Indirect costs	**Risk Reduction:** Provision of alternatives for contingency purposes Availability of better information
Capital reduction: Working capital Fixed capital	**Individual considerations:** Power, control, information, empire-building, status, perk, personal interest, corruption

Purchasers within an institution (MoD) may influence the outcome of a decision in order to gain individual value for themselves. Their prejudices may result in decisions offering reduced value to the institution itself. This personal influence may arise from considerations such as personality, culture, nationality, or previous bad experience with a supplier.

4.30.1 Producing and using value cases

Vendors (Defence suppliers) should always compile comprehensive value cases to support the proposed purchase of their projects, programmes or major products. The overall case is likely to include elements that reflect the perspectives of each of the customer's (MoD's) dominant influencers, including who will own the final decision. These cases represent an essentially positive outlook. 'No' votes are essentially negative value. They often arise from switching costs (See Section 3.55.7.)

The translation of value aspects into monetary terms is not trivial, particularly when it involves risk reduction. One approach is to pick an arbitrary value-to-price ratio, say 5:1. Then see whether values at five times the price are reasonable, rather than tackling the problem the other way round. In each case, the incremental impact should be the best that can be calculated. In most circumstances, it is important to address the impact of source loyalty as well as switching costs, both of which can detract from available value. There is also a need to distinguish between hard or quantifiable benefits and soft benefits, and identify the subsequent value of both.

4.30.2 The application of value models [jj]

In looking at models for industry and commerce, it appears that the sources for MoD of value for money are those shown in Figure 31. Increases in performance and risk reduction will both impact on value.

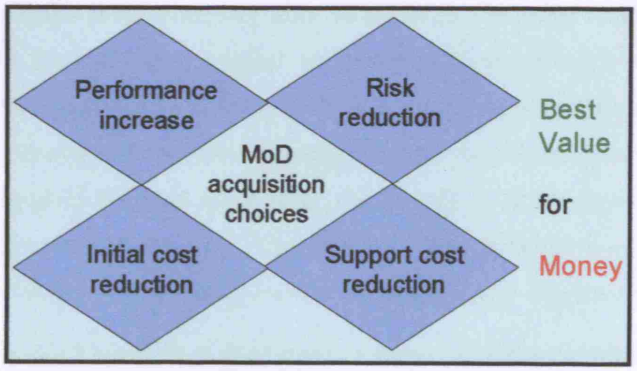


Figure 31 The fundamental factors affecting the achievement of best value for money.

4.30.3 Comment

This book concentrates on the financial part of value for money, which is particularly relevant to commercial organisations, but also highlights the importance of risk and cost reduction.

[jj] These notes resulted from a discussion with Stephen Willson, co-author of Winning Major Business, in December 2001.

4.31 RAMP Risk analysis and management for projects [129]

The RAMP process has been developed to evaluate and control all key risks during the life cycle of major civil engineering projects. [kk] It includes the vital revenue risk that is not applicable to MoD projects. It demonstrates how to identify, analyse and mitigate risks, and then to control the residual risks and how to place financial values on them. Some risks depend on others and many of the probabilities, costs and outcomes are uncertain. The process aims to achieve as much certainty as possible about a long-term and uncertain future.

RAMP deals with the entire life cycle of a project from inception to disposal, as does Smart Acquisition. It consists of four activities: process launch, risk review, risk management and closedown. The launch, for major projects, usually involves appointing a RAMP implementation team. The second activity is a risk review using a risk register, repeated at key stages or decision points. Then each risk is evaluated to determine its likelihood, impact and any relationship between all the various risks. Where apt, a risk mitigation strategy is employed to identify ways to avoid, reduce or transfer risks. For remaining risks, an investment model can be used to estimate the overall riskiness and viability of the project and, assuming it is not aborted, a risk response plan is then prepared. The third activity, risk management is carried out between the risk reviews and involves implementing the risk mitigation strategy and response plan. The last activity is to close down the RAMP process.

RAMP views as important the need to think hard about unforeseen risks; possible outcomes not normally anticipatable because they depend on unusual combinations of circumstances or an unenvisaged change in the underlying situation. An example quoted from the book is the possibility that new warships might have to be sold to other navies, instead of commissioned as intended.

The likelihood of any particular event occurring must be assessed. Often the occurrence or not of a particular risk will depend on whether a number of underlying causes occur on not. Whilst a percentage must be put on the chance of a risk happening, this is unlikely to be known with any degree of certainty, though sensitivity analysis may show whether a figure is realistic. Alternatively a band of likelihoods may be used, though if the band is too wide, and the risk cannot be transferred or avoided, further work may be needed to narrow the band. Uncertainty is more difficult to analyse and manage than risk. The consequences of any risk occurring must be considered as an impact on a project.

Expected value provides a good measure of the financial impact of a risk occurring, the product of its impact and its likelihood. However, the occurrence may not have a single unique impact. There may be a range of possible impacts each with a different probability. In such cases, weighting each of the possible impacts by its own probability, to give an average impact, can be used to derive the expected value of the risks.

[kk] The book refers to the Treasury Consultation document that has now resulted in the April 2003 version of the Green Book.

Four concepts, risk event, likelihood, impact and expected value are at the heart of RAMP and enable a realistic cost to be placed on each risk. Risks can be placed in order of importance and it is feasible to indicate how much it is worth spending to mitigate them. However, care is needed as a low expected value may mask a very low risk with a major financial impact if it occurs. The final factor is the probability distribution of all possible outcomes for any given project. It all requires personal judgement, rather than just mechanical analysis to weigh up possible effects.

Figure 32 shows the six phases of an investment life cycle and highlights the key events that occur between each of the stages.

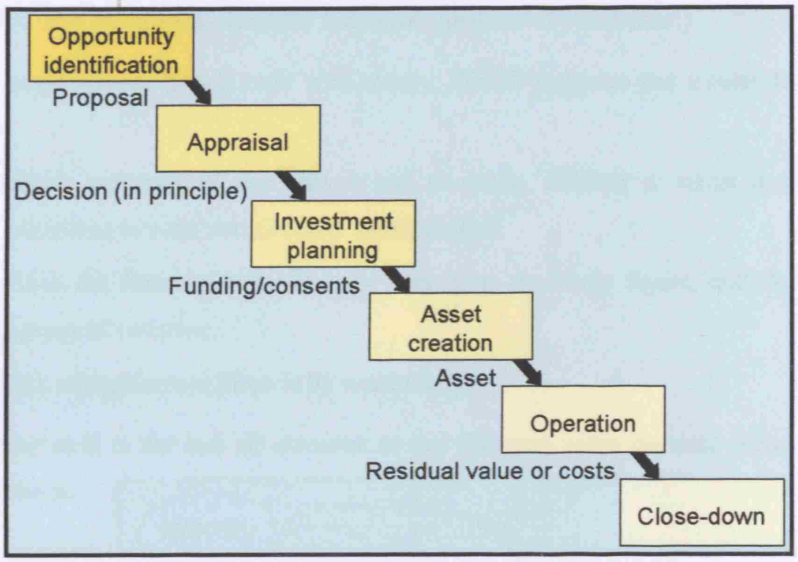


Figure 32 The investment life cycle described in RAMP employs six very similar phases to those used by MoD.

The similarities with the six phases of the CADMID cycle are shown in Figure 33. Inevitably there is more financial orientation in the investment life cycle, as it also includes the question of revenues in an investment model that compares income against costs.

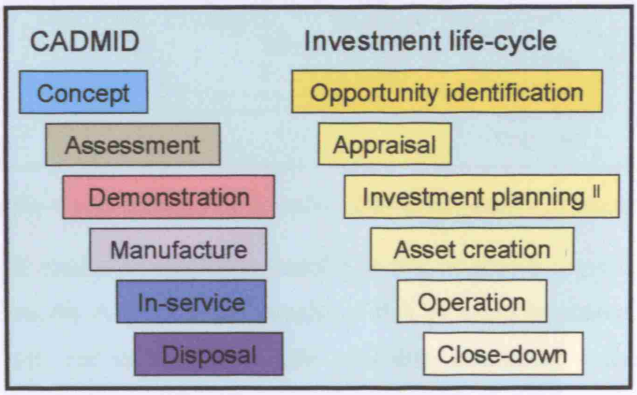


Figure 33 A comparison of the CADMID and RAMP investment life cycles.

The RAMP approach aims to identify, evaluate and manage the risks that could cause a project to vary from its most likely or expected outcome. Three stakeholders are listed:

1. The client – equivalent to the DEC – the project owner accountable for the overall investment.
2. The project manager – corresponding to the IPTL – accountable to the client for the planning and execution of the work to create the asset needed to achieve the objectives of the investment.

[II] Investment planning comprises the procurement of funding, obtaining planning consents, undertaking preliminary design work, planning project implementation, preparing a detailed risk mitigation plan and making a final decision to proceed with the investment.

3. The user – the same as the Second Customer – who is responsible for using the asset to provide the benefits expected from the investment.

The RAMP process requires the appointment of a risk process manager. (The AMS [130] states that all projects should have a risk manager and that the management of risk should be undertaken as a co-operative process between an IPT and its supplier, with the full involvement of the customer.)

While an investment model might appear to deal only with money, RAMP suggests that a suitable model need to be developed to:

1. Estimate the likely financial outcome of the project and ascertain whether it meets any predetermined financial criteria as to what constitutes a viable project.
2. Estimate the extent to which the financial outcome may vary from the likely figure, and the probability of different degrees of variation.
3. Show which methods of risk mitigation are financially worthwhile.

Comment: Item 3 is intriguing as it is the task of actuaries to put financial value on risks using mathematical and statistical methods.

The AMS illustrates the iterative risk-management process with the diagram shown as Figure 34 that requires risks to be identified, analysed and mitigated, with residual risks then controlled. There is no mention of placing a financial value on risk.

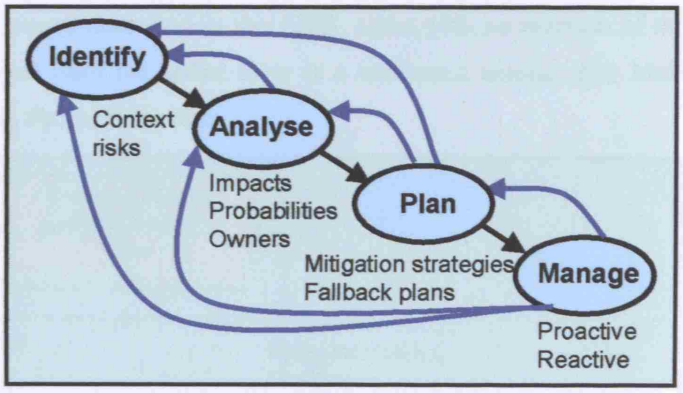


Figure 34 AMS schematic representation of iterative risk-management process.

RAMP suggests four ways of mitigating risk: reduce or eliminate, transfer, avoid, or absorb or pool. One area where the RAMP process differs from the AMS is in the transfer of risk by using insurance. As a government department, MoD is does not use commercially available insurance – the government carries the risk. [131]

The AMS also suggests four ways to deal with risk: treat (reduce), transfer, terminate (avoid), or tolerate (accept). It suggests in Figure 35 overleaf the use of 3 x 3 matrices to quantify risk as high medium or low in each of the three key areas; time, cost and performance, [mm] and then considers the probability of each risk occurring as high, medium or low. A note suggests that more resolution can be added by introducing 'very low' and/or 'very high' criteria to produce a 4 x 4 or 5 x 5 matrix.

[mm] A fourth column could be added to cover 'effective integration'.

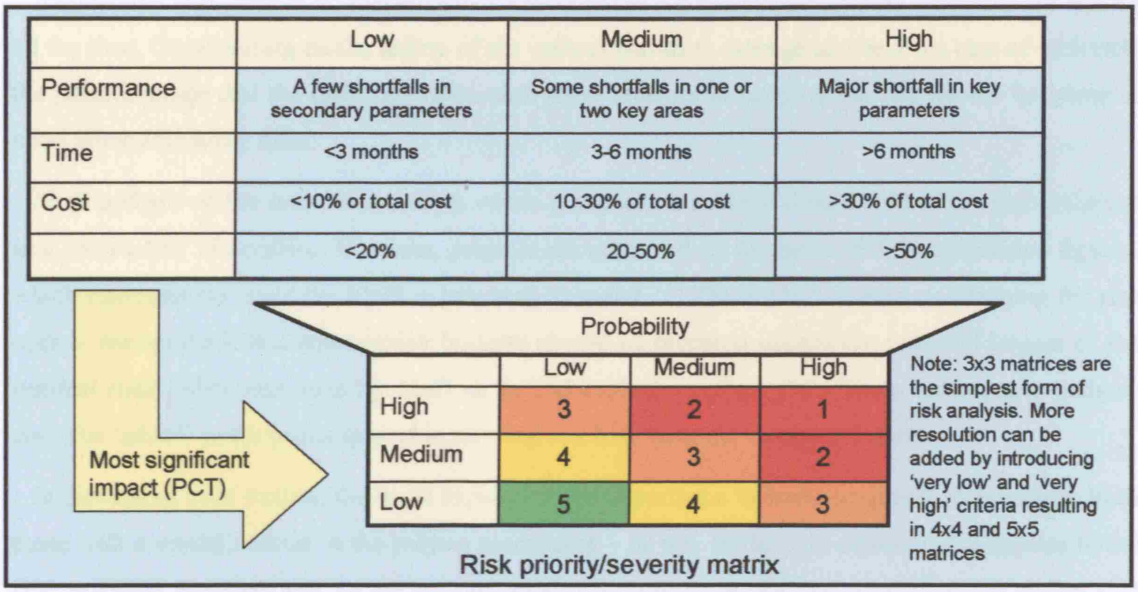


Figure 35 AMS qualitative risk analysis matrices.

Figure 36 outlines the risk analysis process described in the AMS, again with no mention of the possibility of putting a financial value on risks but rather there is a maximum amount that MoD authorises for expenditure on each project that includes risk.

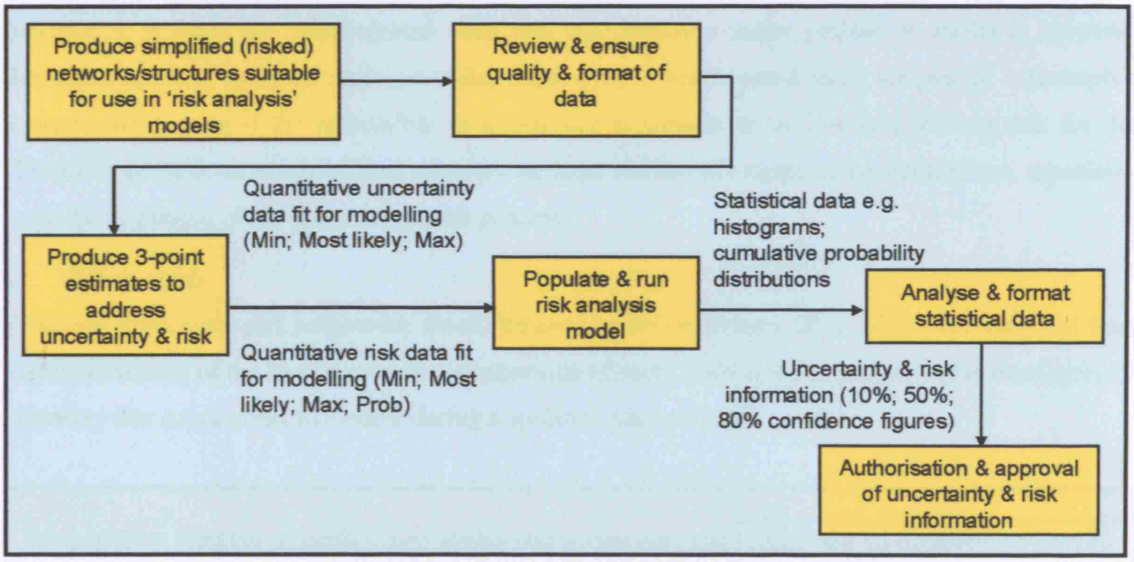


Figure 36 A simplified version of the AMS quantitative risk analysis process. [132]

RAMP highlights the needs to consider risks that may occur during the operating (in-service) phase of a project. These include such relevant items as:

- High operating costs due to high maintenance.
- Product obsolescence.
- Natural disasters (e.g. hurricane or earthquake).
- Fraud.
- Managerial incompetence.

It concludes that there is no feasible all-inclusive list of risks available because new risks are arising all the time. Commenting on the ability of the various parties to manage and bear the cost of each risk, the point is made that the differing value each party attaches to carrying the risk should be borne in mind when allocating risks.

MoD budgets on the basis of estimates which it expects to achieve should 50% of the risks inherent in a programme materialise. However, projects are approved on the basis of 90% confidence figures, which represent the most the MoD is prepared to spend. [133] The RAMP chapter on planning for risk control recommends that contingency budgets should be prepared against the potential impact of the residual risks. Were this done by MoD at the bid evaluation stage, the various contingency budgets could be 'added' to the prices quoted in arriving at a best value for money solution.

In discussing case studies, the book highlights the importance of being sceptical of estimates from those with a vested interest in the project proceeding – or not. In the case of MoD, this applies to the IPT, potential suppliers and, in the case of collaborative projects, foreign departments of defence. It also mentions that perceptions of risk differ from person to person, with specialists in particular domains sometimes underestimating risks within their speciality and overestimating risks outside it.

1 Unforeseen risks

However much effort is put into risk analysis, a totally unexpected event can scuttle well-laid plans. In practice, it is often the unanticipated risks that can destroy a major project or render it obsolete. Identification and study of strategic risks, those events which could have serious or catastrophic consequences, even if the probability of occurrence is thought to be low (the iceberg risk for the Titanic is an obvious example), can often be the most worthwhile aspect to concentrate on, especially near the beginning of the project appraisal process.

2 Risk analysis

Relevant experience and judgement should be used to define a range of possible outcomes and then derive estimates of the likelihood and consequences of each. Likelihood or probability is the degree of certainty that a risk event will occur during a specified time period.

$$\text{Probability} = \frac{\text{Number of occurrences giving rise to that outcome}}{\text{Exposure (i.e. number of possible occurrences)}}$$ (provided all occurrences equally likely and mutually exclusive)

Impact is the value of the effect of the risk event, if it occurs. Normally this will be a financial impact on the capital cost, operating cost or lastly and not relevant to MoD, the revenue.

Expected value provides a good idea of what might reasonably be the overall impact of any category of risks. It is calculated by multiplying the impacts by the associated probabilities of events. It thus

provides an average impact of risk for a large number of identical projects. In order to combine a number of risks that could affect a project, there are two main rules; probability addition and multiplication.

The addition rule: Prob (A or B or both) = Prob (A) + Prob (B) – Prob (A and B).

The multiplication rule: Prob (A and B) = Prob (A) x Prob (B), provided A and B are independent.

Or, if dependent: Prob (A and B) = Prob (A) x Prob (B, given that A has occurred) or (A, given that B has occurred). Implicitly treating risks as if they are totally independent can give seriously misleading results.[134]

3 Real and perceived risks

In most situations, and major project acquisition is one of these, it is impossible to know the real risks faced. Even after the project life cycle has ended it is impossible to know what the true risks were. Specifically, the real risk distribution is not known nor the specific outcome for a particular risk event if it occurs. Perceived risk is a human estimate and differs from real risk, which is the true risk that currently exists. Thus, there will be differences between perceived and real-risk distributions and these differences will change with time. They will also depend on the level of knowledge about the risks and the situation in which they exist. Success in estimating risks depends on:

- Availability of valid data from experience.
- The level of expertise in the area of risk.
- Insight into the underlying causes and factors influencing the outcomes.
- The extent to which the risks are stable or subject to change.
- The reliability of the assumptions.

Even if attempts to measure risk are not entirely successful (it is extremely difficult to measure the degree of precision), there is clearly enormous benefit in analysing and managing risk to the extent that is practicable.

4 Unforeseen and unknown risks

It is unlikely to be possible to identify all risks that could arise in every project, but it is important to identify as many risks as possible in advance and to be vigilant to spot new risks as they occur. An interesting checklist of causes likely to result in unexpected risks is shown in the table overleaf and all should be considered for any major MoD project.

In addition, a risk may have been foreseen, but the impact may prove unexpectedly disastrous. It is also important to recognise that some stakeholders may have differing attitudes to risk compared to other stakeholder, even if the risk of occurrence and consequences if it occurs are known.

New laws, regulations & court judgements	Unexpected financial/economic/political conditions
Reactions to hostile interests	Unexpected design problems
Freaks of nature	Unlikely accidents
Unexpectedly harsh physical environment	Risks that could have been foreseen but were not
Unforeseen man-made hazards	Breach of contract by contractors
New technologies	Fraud and crime
Malignant action by third parties	Inadequate organisation

4.31.1 Comment

As has been shown, the RAMP approach to risk analysis and management for projects has many similarities to the approach recommended in the MoD AMS. However it also contains several improvements that could be used to help minimise the risks associated with major defence projects. RAMP requires risks to be identified and on the whole MoD and its suppliers are good at thinking about risk and producing project risk registers. The likelihood of any particular event occurring must be assessed and a feasibility study is a classic way of doing this.

There are similarities between the RAMP investment life cycle and MoD's CADMID cycle. Both systems involve the appointment of a risk manager, and the AMS requires risks to be identified, analysed and mitigated, with residual risks then controlled. The risk analysis process described in the AMS makes no mention of putting a financial value on risks. MoD budgets on the basis of estimates, which should achieve 50% of the risks inherent in a programme while RAMP suggests considering the transfer of risk by using insurance; a solution not available to MoD. However, projects are approved on the basis of 90% confidence figures, which represent the most the MoD is prepared to spend. [135] To plan for risk control at the bid evaluation stage MoD could add various contingency budgets to the prices quoted to arrive at a best value for money solution. RAMP highlights the importance of being sceptical of estimates put forward by those with a vested interest in a project; be they members of the IPT, potential suppliers or collaborative partners. It also notes that specialists in particular areas may underestimate risks within their speciality and overestimate those outside it.

4.32 Capital Projects [136]

A 'capital project' may be defined in a wide sense as any scheme involving the investment of resources at the outset, in return for the expectation of a net benefit at a later stage. In this paper the term is used in a narrower sense to include only those projects where the investment has significant physical, social or organisational consequences. This definition neatly fits with this research's concentration on major operational equipment.

Since World War II, accountants and financial economists have attempted to convert into a system the process of appraising projects, using a variety of modern management tools, including some

hitherto used mainly by actuaries. Advances have also been made in the physical and financial control of projects, for example in the introduction of critical path analysis and budgeting. Despite these improvements, there are many examples in recent years where capital investment has been wholly or partially wasted, or where the costs have exceeded expectations. (This certainly applies to MoD.)

It therefore seems likely that more and more attention will be paid in future to the appraisal and discussion of proposed capital projects including rigorous analysis. (Note that MoD carries out full appraisals [COEIAs and Business Cases] for all major projects.) One advantage of producing a proper appraisal of a large project is that it may help to secure political acceptability by removing some of the uncertainties in the minds of non-specialists including, perhaps, the decision-makers themselves. (MoD ministers and members of the Cabinet may be considered as non-specialists in defence acquisition.) Moreover, cautious decision-makers (including those in MoD) may feel more comfortable if they can demonstrate later, should things go wrong, that they took every possible precaution at the outset and obtained the best professional advice available.

4.32.1 Probabilistic and systematic risk

It is sometimes helpful to consider project risk under two separate headings – the probabilistic risk (also known as unique risk, specific risk, unsystematic risk or diversifiable risk) which can be eliminated by sufficient diversification over a number of projects (not applicable to individual MoD projects, but helpful across the total DPA and DLO budgets) and the systematic risk which cannot.

In view of the worldwide tendency towards privatisation of commercial activities hitherto undertaken by the state, government projects will increasingly relate to activities that have little commercial potential, (MoD projects usually lack commercial potential) but do offer the promise of benefit to the community as a whole (Individual MoD project community benefits include providing employment for its contractors' staff, exports of defence equipment and some commercially exploitable new technology). One of the difficulties is how to measure that benefit. In the appraisal of government projects, there should also be further study and discussion of the possibility of taking into account any saving to the public purse arising in respect of unemployment benefit and similar factors.

A pioneering study [137] in this field examined the proposal to build London Underground's Victoria Line. It found that much of the social benefit was in timesaving: it was necessary to value this and a somewhat arbitrary figure was selected. It was also necessary to place a monetary value on passenger comfort and convenience. Calculations showed that, ignoring social benefit, the Victoria Line was unlikely to earn enough at then current fares to meet its interest charge after covering operating costs and depreciation. Taking the estimated social benefits into account as well as capital and running costs, however, there was sufficient justification to construct the Line, despite the expected financial loss for London Transport. After more than 25 years, people would probably say that the Victoria Line has proved a great asset to London, and that the decision to go ahead was justified.

Analysis of this kind, generally described as cost-benefit analysis, has been used for many subsequent government projects, and it seems clear that the approach is here to stay. The quantified social benefits can be treated in the appraisal calculations just as though they were cash flows. (This could be an interesting calculation for MoD.) It is important to ensure that all the social disbenefits of a project are measured, as well as its positive benefits. From the viewpoint of risk and sensitivity analysis, the uncertainties necessarily involved in quantifying social benefits pose wider challenges than if financial considerations alone were involved.

Risk categorisation in this paper is interestingly divided as follows. Those only involving money are shown in italics:

Generic cause	Sub-Categories	
Political	(a) Government	(d) Legislation
	(b) Public opinion	(e) Wars, terrorism, riots
	(c) Environmental change	(f) Public relations
Business	(a) Demand failure	(c) Premature obsolescence
	(b) Competition	(d) Safety standards
Economic	(a) *Cost inflation and interest rates*	(c) *Extreme economic conditions*
	(b) *Currency fluctuations*	
Project	(a) Definition	(g) Resourcing
	(b) Technical innovation	(h) Legal framework
	(c) Leadership	(i) Progress
	(d) Technical competence	(j) Labour relations
	(e) Commitment	(k) Human error or incompetence
	(f) Planning and control	
Natural	(a) Weather	(c) Fire or explosion
	(b) Earthquake	(d) Ground conditions.
Financial	(a) *Inadequate margins*	(b) Unbalanced sharing of risk

4.32.2 Risk quantification

Having identified each risk, it needs to be quantified. Risks vary from the very likely to the extremely improbable. If the event that is the subject of the risk occurs, the impact on the project may be large or small. Risks may be controllable or non-controllable. They may be interdependent or independent. Each risk can be given a classification according to the following scheme. Again those that involve revenue and are thus not applicable to MoD are in italics.

Risk level	1 Very likely	4 Unlikely
	2 Likely	5 Very unlikely
	3 Even chance	
Dependence	1 Very high degree	4 Quite a low degree
	2 Quite a high degree	5 A very low degree
	3 Fair	
Controllability	1 Very controllable	4 Rather uncontrollable
	2 Quite controllable	5 Very uncontrollable
	3 Controllable to some extent	
Impact	1 Project cancelled	4 *Slightly reduced revenues*
	2 Considerably increased cost or delay	5 Slightly increased cost or delay
	3 *Much reduced revenues*	

4.32.3 Risk management

Once a factor has been classified, consideration will be given to how the particular risk should be managed. There are a number of possible responses:

a. Absorb – An appropriate contingency margin added to the costs.
b. Reduce – Improve design, carry out further research or study, strengthen management, optimise timing, avoid new technology, avoid risky techniques and change implementation plan.
c. Pool – Share the risk with other parties.
d. Transfer – Transfer risk to another of the parties, e.g. to a contractor better able to control it.
e. Insure – Pay to pass all or part of the risk to an insurance company. (Not an option for MoD).
f. Avoid – Do not proceed with project in a form involving this risk.

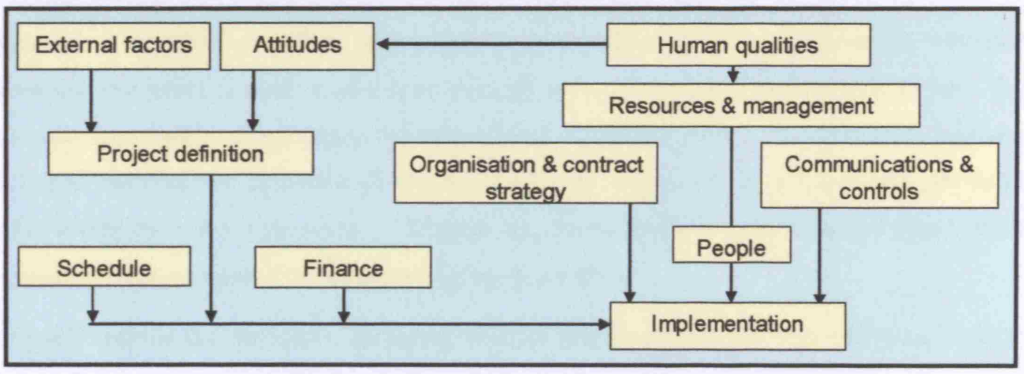


Figure 37 Research Model: Preconditions of project success [138]

Figure 37 shows a model from the paper that indicates the areas that need consideration when evaluating project risks prior to implementation of a project.

4.32.4 Conclusions

An actuarial perspective can add value to the appraisal of a capital project and can contribute to the overall assessment undertaken by an appraisal team that includes other professionals, such as engineers, economists, planners and accountants. The unique value of actuaries' contributions derives from their training, skills and experience in risk management and finance, both separately and in conjunction. They have developed techniques that enable them to make long-term forecasts with confidence, and present results in ways which senior management can easily assimilate as a basis for decisions. Moreover, their background in finance and investment can assist in finding the most appropriate funding structure for projects, having regard to the risks that each party is prepared to bear.

4.32.5 Comment

There are examples where MoD's capital investment has been wholly or partially wasted, and where the costs have exceeded expectations. How far are the approaches mentioned in this paper relevant to MoD? Actuaries have recently expanded their remit to cover large civil engineering projects, an approach that could equally be applied to military projects, with the caveat that factors involving revenue are not relevant. Individual MoD projects offer the promise of employment, balance of payments and exploitable new technology as benefits to the nation. Although hard to measure, it could be advantageous for MoD to quantify these benefits and treat them as economic factors in appraisal calculations.

4.33 Megaprojects and Risk: An Anatomy of Ambition [139]

This book focuses on three large civil engineering projects: the Channel Tunnel, the Danish Great Belt Bridge and Tunnel, and the Oresund bridge/tunnel connecting Denmark and Sweden. In all three cases building costs (and timescales) exceeded estimates and revenues were below the forecast; common characteristics on these types of project across the world. The book mentions many other large civil engineering project and points out that problems in cost and timescale are often the result of '*the promoters of multibillion-dollar megaprojects systematically and self-servingly misinforming Parliaments, the public and the media in order to get projects approved and built. It shows... how the formula for approval is an unhealthy cocktail of underestimated costs ... undervalued environmental impacts and undervalued economic development effects. This results in projects that are extremely risky but where the risk is concealed ...*' Despite this, the number and size of infrastructure projects is still growing, forming what is called the megaproject paradox.

The book records the problems, including lack of post-project audits, but offers little advice on resolving them. The main difficulty is identified as a lack of accountability during the project life cycle. A potential solution that does little to assist involves a strong private capital sector working without government guarantees, but with more consideration for genuine risk assessment; risk assessment tools being firmly established and generally well understood. The book acknowledges that

political interplay between government and the private sector determines the extent to which appropriate risk assessment and management tools are employed.

This interplay is inherent with these types of project. Policy-makers want the private sector to take the risks, but are often unwilling to agree to a commensurate return. Private companies, on the other hand, want some insurance against the drawbacks. This matches the approach by MoD and its suppliers both on conventional procurements and on PFI projects.

The benefit of this book is that it raises awareness of the poor track record afflicting these types of project that have some similarities to major defence projects. It is interesting to note that in mid-2005, Eurotunnel faces bankruptcy due to its debt burden, yet few would question the benefits the tunnel has brought to the UK and France.

4.33.1 Comment

Could the megaproject paradox also apply to major defence projects? They are certainly large enough and feature many of the characteristics of large civil engineering project – huge budgets, long timescales, large overspends and timescale delays. Tornado and Joint Strike Fighter/CVF spring to mind. Of course, the term 'financial viability' does not apply since these projects are not revenue earning for MoD.

Looking at the 'promoters' of large defence projects, by Main Gate they include the DEC, the IPTL and the heads of the short-listed prime contractors and their local MPs, not to mention MoD ministers. Undoubtedly industry has the habit of quoting low figures and optimistic timescales for these types of project in order to get into the winning position and hard-pressed MoD officials have accepted suggested budgetary figures so as to fit them into their tight budgets. Thus, by the time tenders are submitted, cost and delivery time have been frozen in the minds of the procurement team.

4.34 Facilitating bid evaluation in public call for tenders: a socio-technical approach [140]

This paper examines a specific multi-criteria socio-technical approach to facilitating bid evaluation and discusses several issues that warrant its use. It employs some real-world examples of international public calls for tender to illustrate practical aspects of structuring criteria and creating a computer-based additive value model that directly interacts with evaluation committees responsible for bid evaluation, supported by the use of multi-criteria decision analysis software.

It makes a valid point that the awarding authority is legally obliged to publish, in its call for tenders, the evaluation criteria and their respective weights, or at least their order of relative importance. As a result, once the criteria have been published, it is legally unacceptable to evaluate the bids using criteria or a scoring system not indicated in the call for tenders. This restriction makes the evaluation of bids by criteria such as technical quality difficult. This is particularly so for projects or equipment of great complexity, since there are usually numerous criteria, features and weightings that should be taken into consideration.

The requirement to publish criteria (and sub-criteria) weights implies that they must be defined before the contents of the bids are examined. This introduces another problem, since the elicitation of 'weights' without reference to actual variations of the criteria once the bids have been submitted is theoretically incorrect and has no mathematical meaning in the framework of an additive aggregation model such as that shown in Figure 38.

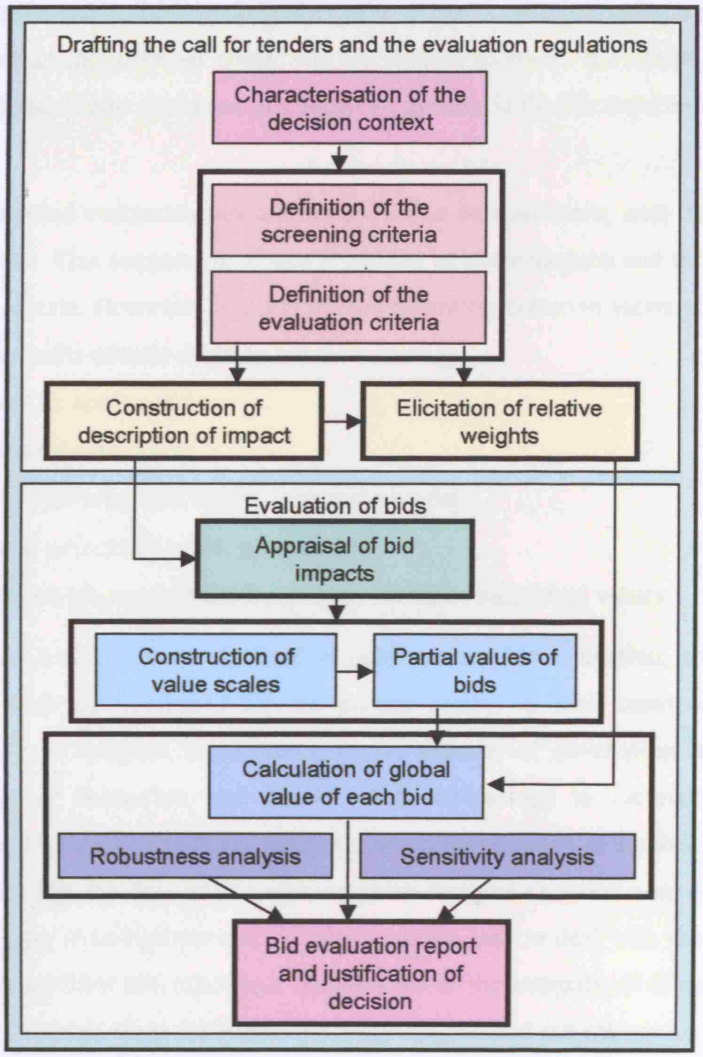


Figure 38 Fig. 1 from the document – Methodological diagram. Each bold-framed box typically corresponds to one (or more, depending on the complexity of the case) decision conference.

1 An additive aggregation model

$$V(b) = \sum_{j=1}^{n} k_j \, v_j(b) \text{ with } \sum_{j=1}^{n} k_j = 1$$

where: V(b) = value of a bid; vj (b) = partial value of the bid in each criteria (j=1, ... ,n); b = bid; k = weightings; j = criteria; n = number of criteria.

This model can calculate its overall value V(b) simultaneously taking into account n criteria. If sub-criteria are present, the procedure is applied first for each group of sub-criteria sharing the same parent criterion. The parameters k_j are the scaling factors – commonly called 'weighting coefficients' or relative 'weights' – that allow partial value units to be transformed into overall value units through some form of trade-off, between criteria by the evaluation committee.

The compensatory additive aggregation procedure is the simplest and the most frequently used multi-criteria method, allowing both the ordering of the bids in terms of overall attractiveness and judging to what extent one bid is better than another.

The paper then concentrates on a case study that used multi-criteria decision analysis software during the contractor selection stage of an international public call for tenders to award the design, construction, equipment, financing and short-term operation of a light-rail system in the Metropolitan Area of Porto in 1996.

The paper's conclusions state that each bid evaluation process has proved to be distinctive, with its own problems and specific characteristics. This suggests prudence is needed in generalisation and the extrapolation of conclusions to other contexts. However, it points out the following common views of each evaluation committee, in regards to multi-criteria decision aid methodology:

- Agreement with the assumptions of its application.
- Assimilation of its essential theoretical principles.
- Agreement with the sequence of phases proposed for the evaluation model.
- Satisfaction with the coherence and correctness of the procedures.
- Approval of the qualitative judgement process and the freedom to verbalise individual values.

Finally, there are two key conclusions derived from reflecting on public-sector bid evaluation, as well as other multi-criteria decision analyses developed for the private sector. In both cases a constructive decision-aid attitude has been adopted, contributing to the process of developing a common language for stimulating group interaction and debate, using technology to increase assessors' knowledge of their problems and help to find their own solutions. Bid evaluation in a public call for tenders is demanding: it is not enough for the decision-making group to agree on a decision; it is also necessary to justify it in a clear and unambiguous way. Finally, it is not easy to deal with the tension in evaluation committees resulting from potential legal disputes about the integrity of their judgements and decisions. However, in a recent legal challenge, the judge emphasised the robustness and correctness of the multi-criteria methodology applied in the bid evaluation.

4.34.2 Comment

MoD uses multi-criteria decision-analysis software programs, though not the one used in this case study. The paper confirms the legal need to publish all the evaluation criteria and their weights, or order of importance, in calls for tenders. This restriction increases the difficulty of bid evaluation, particularly for very complex projects such as the MoD ones the subject of this research. It may be reassuring that a legal challenge has resulted in confirmation of the robustness and correctness of using multi-criteria methodology in the bid evaluation, but this ruling would apply only to the MoD COEIA, not to its associated Business Case.

4.35 Conquering Complexity [141]

During the second half of 2004 and the first quarter of 2005, the author of this thesis was also editor of a book written by eight members of the Defence Engineering Group to encapsulate the material taught in the MSc in defence acquisition. He also wrote 40% of the text – some 48,000 words. These include

sections relevant to this thesis on the evolution of UK defence procurement, military capability, Smart Acquisition, affordability and achieving best value for money, PPP and PFI, and supplier issues. There is inevitably and rightly significant overlap between these sections and the contents of this research.

Chapter 5 of the book describes the COEIA process used to assist decision-making on the selection of defence equipment by helping to identify, from a range of proposed projects, the option offering the MoD best value for money. A COEIA includes only assessment of military and financial issues, so its results must be considered alongside other wider factors (such as industrial and diplomatic) that might influence MoD's procurement decision.

The assessment includes parallel analyses to determine its Operational Effectiveness (OE) in war (its value) and an Investment Appraisal (IA) of its through-life cost in peace. The proposal's OE is obtained by operational analysis, modelling its performance in several scenarios against specified hostile forces. Operational analysis has the advantage that it yields a relatively small number of Measures of Effectiveness (MoE) for the proposed equipment and its enables quality/quantity trade-offs by comparing the effectiveness of the proposed equipment with that of larger numbers of a cheaper variant. The main disadvantage of operational analysis is that it requires sophisticated models of military operations to be developed and validated at considerable expense for the assessment of a particular project, and which must win the confidence of all the stakeholders.

When the COEIA was introduced, modelling individual weapon systems and their effects on the enemy was well understood but it was harder to model the operational effects of improvements in C^3I systems, conveying more or better or faster information between commanders. Such systems continued to be assessed by traditional methods, using judgement to relate their performance to the quality of a commander's decisions, but recent studies now provide a rationale for more rigorous quantitative assessments of the value of information.

The presentation of COEIA results must synthesise and illuminate the military and the financial aspects of the alternative proposals. The results are presented, along with industrial, political and diplomatic factors, in the Business Case submitted to the IAB, seeking authority to invest in the next phase of a project. The Business Case has a limited number of pages (currently 30) but can refer to supporting papers containing more-detailed data and analyses.

The results of COEIA studies on alternative proposals may be presented as points on a cost-effectiveness graph whose axes are the proposals' effectiveness in war and the Net Present Value of the associated expenditure in peace. When practical the results for each option are scaled to provide the same enhancement of military capability, allowing comparison of cost at constant capability. In cases where the number of operational units or organisational units is small (it is impractical to procure 3.5 ships) the option must be scaled in discrete steps to get as close as possible to the target capability.

In Figure 39, each plotted point has been replaced by an ellipse scaled to represent the assessed risks to the cost and effectiveness of that proposal and the robustness of its results to variations in the scenario assumptions.

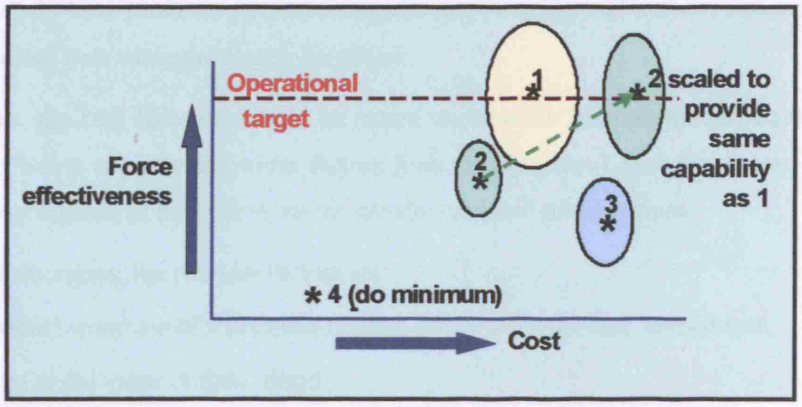


Figure 39 Four cost-effectiveness options – 1, 2 (as is and scaled), 3 and the do minimum option 4.

Each plotted point (or ellipse) summarises time profiles of effectiveness and expenditure through the time period of the COEIA, and each offering should be examined to ensure that these profiles do not contain unacceptable troughs in effectiveness or unacceptable peaks in expenditure. If such peaks or troughs do exist, they may need to be eliminated by adopting different plans for scheduling and/or financing before being re-assessed on the amended basis.

4.35.1 Comment

This description of the COEIA confirms the effectiveness of its approach, in contrast to the information presented in the Business Case. It leaves open the difficulties involved in comparing solutions when only a few items are being procured.

4.36 Business Guidance: Value for Money Measurement [142]

The title of this OGC paper appears related exactly to the subject of this research. It is, however, a great disappointment. All it deals with is how to reduce costs – the cost of what is acquired by negotiating with the supplier or by aggregating demands, the cost of carrying out the acquisition by reducing process or transaction costs and improving project, contract and asset management.

While reducing cost is one way of increasing value for money, and a way that is relatively straightforward to measure, it fails to address the non-financial aspects of value. One point of interest is the question of aggregating demands.

4.36.1 Comment

For major equipment acquisitions, MoD is the only UK customer, but it does suggest that MoD's habit of purchasing platforms in tranches, where large quantities are required, may not be a best value for money solution. It is usually, however, driven by perceived affordability.

4.37 Summary of other literature

Some seventeen books and papers have provided an interesting and more commercial view of some of the issues MoD faces in procuring best value for money solutions.

1. When making decisions, the IAB faces relying to an extent on intuition because mathematical models are not used to weave together the wider factors found in Business Cases and because computers are better than humans at integrating many one-dimensional sub-decisions.
2. In making procurement decisions, the two key factors are:
   a. The value that individual members of a decision-making group place on their assessment.
   b. The importance given to the value of their views.
3. While MoD has recognised the importance and advantages of the use, in bid selection, of decision-analysis software, its application is not compulsory. The legal robustness and correctness of using multi-criteria methodology in the bid evaluation has been established, and this ruling applies to COEIAs but not to Business Cases. In addition, the MoD approach leaves problems when comparing solutions if only a few items are being procured. When evaluating competing tenders, innovative approaches should be judged on whether they have the potential to increase value for money.
4. The US DoD has concentrated on contractor potential performance and risk, in addition to the factors normally assessed in a COEIA. The approach has resulted in an astonishing reduction in the risk of contractor default in the US and possibly could do the same in the UK.
5. It is important to decide what is meant by value, understand that value is relative not absolute and understand the importance of evaluating how information adds value. It should be noted that value depends on its context, changes with time, varies within different parts of an organisation and depends on the actions of enemies.
6. The RAMP approach could reduce the risks associated with major defence projects by putting a financial value on risks, by being sceptical of estimates put forward by those with vested interests and appreciating the dangers of specialists miscalculating risks within their speciality and outside it. To plan for risk control at the bid evaluation stage MoD could add various contingency budgets to the prices quoted to arrive at a best value for money solution.
7. Although hard to measure, it could be advantageous for MoD to quantify the promise of employment, balance of payments and exploitable new technology as benefits to the nation and treat them in appraisal calculations as if they were economic factors.
8. There are dangers that industry quotes, and MoD accepts, low figures and optimistic timescales for major projects, effectively establishing them as de facto baselines. MoD's purchase of platforms in tranches is unlikely to be a best value for money solution.

5 MODELS OF VALUE

One of the critical aims of this research was to examine those models and software programs available for measuring value and aiding decision making, already used either by MoD or by others, to see whether there is any scope for using them to improve MoD's bid evaluation methodology. This section first examines a range of relevant theories, processes, diagrams, models and analysis methods that are fundamental either to value measurement or the process of decision-making. It then considers three commercial bid-assessment software programs before exploring five tools that are already in use by MoD during tender evaluation.

5.1 What models of value exist? (including those in private and other public sectors)

There are several potentially suitable models of value, some with associated software programs. Time has been spent searching for other models and algorithms, particularly those associated with decision-making, and deciding which could prove useful.

The need for decision analysis is driven by several factors. These include the complexity of MoD and what it procures, the vast quantity of available information, issues of uncertainty and risk, the requirement for groups to make decisions, and multiple and often conflicting objectives of the members of the different organisations within MoD that make up each group. These factors indicate the need to provide a rational decision-making framework.

Thus a set of decision-making rules must be defined. These rules must address the values of the problem-owners and it must be possible to articulate their preferences and perceptions. The rules must state what it is to be rational in the face of perceptions of uncertainty and must provide means of steering the thinking of the decision-makers through complex problems.

There are many diverse theories and approaches, ranging from the highly mathematical utility theory to inspired guesses. They have varied applications in many different fields. Some have proved successful, others less so. Consideration has been given to risk, axioms for rational decision-making, value functions, multi-attribute value theory, utility theory, probability, multi-stage decision-making, group decision-making and measurement issues. These factors are considered relevant to MoD, where the decisions on equipment acquisition are almost invariably be made under conditions of uncertainty.

5.1.1 Value flow charts

The Treasury's value flow chart, reproduced in Figure 40 overleaf, is one way of highlighting some of the difficulties to be faced in measuring value for money. These difficulties include whether significant factors can be measured in established units or by some devised scoring system and whether they can be quantified and valued. Consideration is then required to see if a weighting system can be devised before arriving at a measure of output, or a matrix or impact statement.

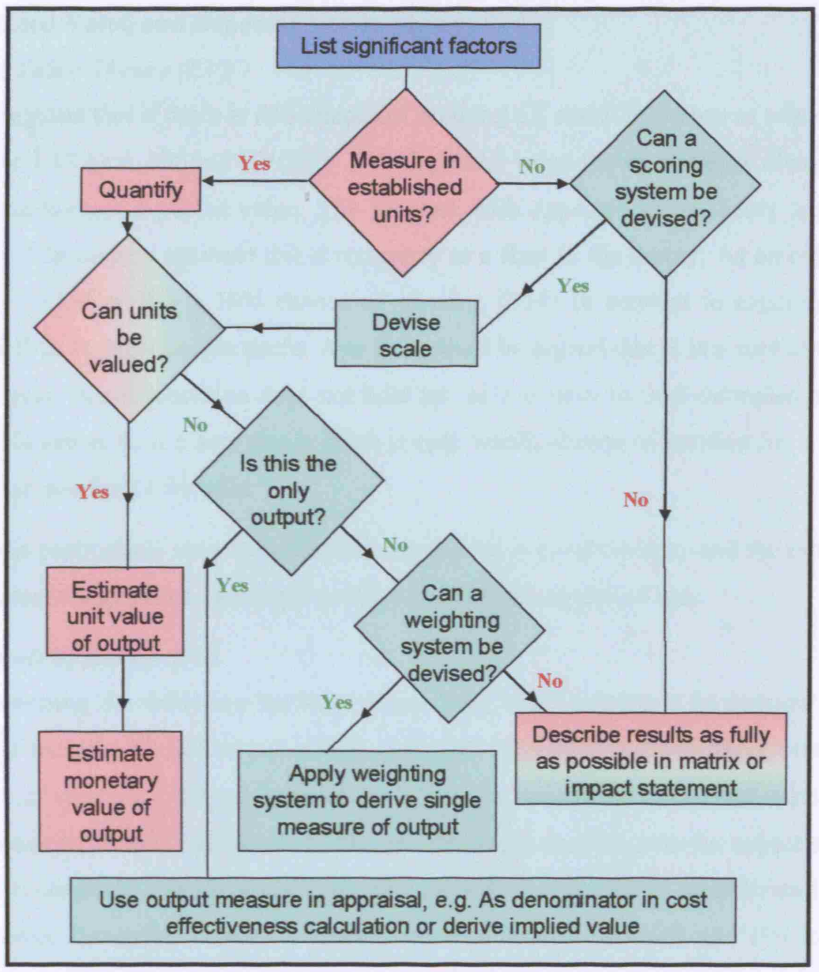


Figure 40 A Treasury value flow chart marked up to show in green the path needed to measure value, and in red the path followed to measure money. Describing results as fully as possible in matrix or impact statement shows an inability to measure value. [143]

5.1.2 Multi-criteria decision-making [144]

This paper discusses the fundamental requirements of value theory. An individual's preferences in a defined context can be classified by a value function V( ), such that if option A is preferred to option B then V(A) >V(B). 'Option' is used in a broad sense and is clearly relevant to the type of MoD equipment acquisitions being studied. However, the individual's preferences must satisfy the two following characteristics. Consider three possible options, A, B and C. If A is preferred to B and B is preferred to C, then A should be preferred to C. However, this may not always be so. Preferences may be intransitive, for example due to changes of inclination with time and circumstance. Value theory demands that in a static situation preferences should be transitive. The second condition, comparability, requires that a choice is made whether V(A) >V(B) or V(B) >V(A) or V(A) =V(B). This is the type of situation faced by the IAB when considering and IPT recommendations for placing a contract.

5.1.3 Expected Value and Expected Utility Theory [145]

1 Expected Value Theory (EV)

This theory suggests that if there is A% chance of winning £X and B% chance of winning £Y then the expected value EV(A) = AX and EV(B) = BY. Expected value theory suggests always choosing the option with the highest expected value. The problem with expected value theory is that it conflicts with intuition. Researchers attribute this discrepancy to a flaw in the theory. As an example, which is preferable, A – £1M or B – a 50% chance of winning £3M? In contrast to expected value theory, which prefers B to A, most people prefer A to B. It could be argued that A is a sure thing whilst B is a gamble. However, this explanation does not hold up, as it is easy to find examples in which people prefer a gamble rather than a sure thing. Most people would choose to gamble for a 50% chance of £100 rather than receive £1 for sure.

This theory is particularly interesting because to gamble is to take a risk, and the types of decisions made in equipment acquisition inevitably involve a significant degree of risk.

2 Expected utility theory (EU)

A way of examining the difference between a sure thing and a gamble is to consider two options: a 95% chance of winning £1 million and a 50% chance of winning £3 million. Here, most people prefer a 95% chance of winning £1M but both are gambles. The reason for this is that winning £3M is not really three times as desirable as winning £1M and this is the answer given by expected utility theory. It is possible to construct a utility scale to try and quantify the amount of satisfaction (utility) derived from each option. Using the number 0 to correspond to winning nothing and 100 to correspond to winning £3M, suppose 80 corresponds to winning £1M. This means that the value of winning an initial £1M is four times greater than the value of winning a further £2M.

We can express the original choice between A and B in terms of these units (utiles) instead of pounds i.e. A – 80 utiles for sure or B – 50% chance of 100 utiles. Calculation of expected utility uses the same general formula as that for expected value but multiplying probabilities with utility amounts rather than pound amounts. That is, A = 100% x 80 = 80 utiles while B = 50% x 100 = 50 utiles, leading to the choice of option A.

EU theory captures the very important intuition that there is diminishing marginal utility of money. The value of an additional pound decreases as total wealth increases. The impact of going from 0 to £1M is larger than the change going from £1M to £3M.

Again, this theory involves gambling and taking risks, and has a relevance to MoD acquisitions.

3 Main difference between EV and EU

In expected value theory, the correct choice is the same for everyone. In expected utility theory, what is right for one person is not necessarily right for another. EV also gives very specific advice: choose A or choose B or there is no difference between the two. In contrast, EU theory is less specific

depending on the assigned utiles and shows that different people might choose different things. It is also very easy to show that a person's choices conflict with expected value theory. This is because EV theory always specifies a right answer to a choice of options. In contrast, it is very difficult to show that a person's choices conflict with expected utility theory.

This suggests that EU is more suited to MoD acquisition decisions since group consensus or a majority are being sought when selecting a contractor. There is a further difficulty. Money and utiles are readily measured. The ability of a supplier to implement a contract without any variation in timescale, cost, performance or ease of integration is always open to doubt in major equipment purchases.

5.1.4 Multi-attribute Value Theory (MAVT) [146]

A number of multi-criteria decision-support techniques have emerged in recent years that use varying computational approaches to arrive at the most desirable solution, and thereby 'recommend' a course of action. Decision-makers who use the results of this analytical work should be assured that supporting analysts and decision-support software produce appropriate solutions. A series of simulation experiments compared the top-ranked options resulting from the computational algorithms that support MAVT and three methods that allow rank reversals when an unrelated option is added or deleted: the Analytical Hierarchy Process (AHP), Percentaging, and the Technique for order preference by similarity to ideal solution (TOPSIS). A Fuzzy algorithm [nn] was also included to gauge its consistency with the other algorithms, even though it is not subject to rank reversals. These experiments demonstrated that the MAVT and AHP techniques, when provided with the same decision-outcome data, often identify the same alternative as 'best'. The other techniques are noticeably less consistent with MAVT; the Fuzzy algorithm being the least consistent. The situations under which the most frequent and significant differences occurred depended on the method.

The results of experiments indicate that the processes used for problem structuring and the elicitation of value weights are likely to be of greater significance to problem outcome than the choice between the computational algorithms of MAVT and AHP. The results cause concern about the use of the other methods. This suggests that while either MAVT or AHP could help MoD in its decision-making process by the IAB, it is structuring problems and allocating weights to values that are the real issues.

5.1.5 Multi-Criteria Analysis (MCA)

The scope and objectives of *Multi-Criteria Analysis: A Manual* [147] are to provide guidance for government officials and others on how to undertake and make the best use of multi-criteria analysis for appraising decisions. It covers a range of techniques of practical value to public decision-makers, increasingly being used in the UK and abroad. The manual describes techniques that do not necessarily rely on monetary valuations, provides practical guidance on the application of these

[nn] Proposed by Yager.

techniques and also has detailed appendices on various MCA methodologies. One source of confusion is the variety of different techniques such as multi-criteria decision analysis, multi-attribute utility theory, the analytic hierarchy process, and fuzzy-set theory. The manual outlines the relationships between the different techniques and indicates the ones that can yield the most fruitful applications, in contrast to those of theoretical interest but little practical value. A guide to software describes the main software tools available in Spring 2000 to apply the techniques in practice. The contents of this manual support the approach to decision-making outlined in the AMS.

5.1.6 Multi-Attribute Utility Theory (MAUT) [148]

Multi-Attribute Utility Theory is an evaluation scheme that is very popular for assessing products. According to MAUT, the overall evaluation of an object is defined as a weighted addition of its evaluation with respect to its relevant value dimensions. The common denominator of all these dimensions is the utility for the evaluator. This is similar to the COEIA approach.

5.1.7 Analytic Hierarchy Process (AHP) [149]

The AHP takes an objective mathematical approach to process the inescapably subjective and personal preferences of a group in making a decision. MoD aims to avoid subjective and personal preferences in decisions made by IPTs and the IAB.

5.1.8 Analytical Network Process (ANP) [150]

An outline of ANP includes determining the control hierarchies with their criteria for comparing the components of a system and their sub-criteria for comparing elements of the system. It contains four hierarchies for benefits, costs, opportunities and risks. In some cases, if a hierarchy does not apply because its criteria are all unimportant, it leaves out that hierarchy. In this research, clearly, cost will not be relevant as a hierarchy since it is part of money and not value. Benefits and risk, both part of value are appropriate but opportunities do not seem to be a part of getting value for money.

5.1.9 Value-focused Influence Diagrams [151]

Over the three decades up to the mid-90s, improvements in computers and computational sciences have enabled automated support for increasingly complex decisions, such as the influence diagram. While these improvements are valuable to the field of decision analysis, current graphical methods do not specify a cohesive and comprehensive process for identifying and structuring the interactions of options, values, and uncertainties during the initial development of a decision model. The first formally specified, integrated process for structuring complex decision models is called a Value Focused Influence Diagram. A formal definition of special case nodes explicitly articulates a decision-maker's fundamental objectives. The process has been proved exhaustive, sound, and consistent with current computational conventions of influence diagrams. The assessment process decomposes the decision situation and utilises a collection of structured queries to identify relevant issues of fact and value. Decision Directed Similarity Networks improve methods of refining the value and decision space, and Bi-Polar Assessment Graphs identify a set of relevant uncertainties that explain extreme

values of attributes in sub-models. After the structured queries provide the requisite information for the sub-models, the process-construction stage organises the information into a single network that preserves the integrity of the probabilistic model implied by each sub-model. Additionally, the value-focused process increases the emphasis on decision-makers' values and helps to correct for common judgmental biases. This decision-structuring process defines and reduces the assessment burden on decision-makers and analysts. MoD has always recognised the value of diagrams and these are extensively used in COEIAs. Furthermore, the use by IPTs of data processing is encouraged, though none of the recommended software programs is mandated for use when evaluating bids.

5.1.10 Value Dashboards [oo]

A value dashboard is a custom-designed software tool that can be applied to a variety of applications of a service or piece of capital equipment. The dashboard provides a financial comparison of the present situation with a proposed situation as a result of how much value each generates. Value is defined as extra revenue, reduced cost, reduced risk or reduced capital.

Value dashboards are typically created as tools for organisations selling capital equipment or services. During the selling process the value dashboard provides a measure of customer value that will be generated. After the sale is made, the dashboard provides the proof of the level of customer value that is delivered. The dashboard typically becomes part of the customer's ongoing management measures used to evaluate potential changes in equipment configuration and operational methods. Selling organisations also gain profound insights into the value-adding function of their offering so contributing towards the design of superior subsequent offerings. The only part of a value dashboard relevant to MoD in the context of this research is reduced risk.

5.1.11 Capability Maturity Models [152]

The Capability Maturity Model for Software (SW-CMM)® and the Systems Engineering Capability Maturity Model (SE-CMM)®, have both been used by the US Army for measuring process risk. The latter, in particular, may be helpful in examining value aspects of risk; an area of importance to MoD.

5.1.12 Multiple-Criteria Decision Analysis (MCDA)

Belton, writing in 1990 about MCDA[153] said that multiple-criteria decision-making approaches seek to take explicit account of more than one criterion in supporting the decision process. It is becoming widely recognised that there are substantial benefits to be gained in practice from their use.

MCDA procedures offer a useful approach to a number of applications in areas such as business and budget-allocation problems where complex, confusing problems are frequently encountered in real life and typically involve consideration of a wide range of criteria. This makes MCDA highly applicable to MoD acquisitions and the software that MoD uses has been specially developed from MCDA.

[oo] These notes resulted from a discussion with Stephen Willson in December 2001.

A criterion is a means by which one particular choice or course of action can be judged as more desirable than another. In a multiple-criteria decision-making problem a decision-maker uses several conflicting criteria to assess the desirability of different decision alternatives. The aim of multiple criteria decision analysis (MCDA) is to help the decision-maker in such situations. [154]

The Department for Transport, Local Government and the Regions multi-criteria analysis manual [155] provides a useful definition of MCDA. It states that: '*MCDA is both an approach and a set of techniques, with the goal of providing an overall ordering of options, from the most preferred to the least preferred option.*' The options may differ in the extent to which they achieve several objectives, and no one option will obviously be best in achieving all objectives. In addition, some conflict or trade-off is usually evident amongst the objectives; options that are more beneficial are also usually more costly, for example. Costs and benefits typically conflict, but so can short-term benefits compared to long-term ones, and risks may be greater for the otherwise more beneficial options.

MCDA is a way of looking at complex problems that are characterised by any mixture of monetary and non-monetary objectives, of breaking the problem into more manageable pieces to allow data and judgments to be brought to bear on the pieces, and then of reassembling the pieces to present a coherent overall picture to decision-makers. The purpose is to serve as an aid to thinking and decision-making, but not to take the decision. As a set of techniques, MCDA provides different ways of disaggregating a complex problem, of measuring the extent to which options achieve objectives, of weighting the objectives, and of reassembling the pieces. Fortunately, various computer programs that are easy to use have been developed to assist the technical aspects of MCDA.

Keeney and Raiffa gave the first complete exposition of MCDA in 1976. [156] They built on decision theory, which most people associated with decision trees, modelling of uncertainty and the expected utility rule. By extending decision theory to accommodate multi-attributed consequences, Keeney and Raiffa provided a theoretically sound integration of the uncertainty associated with future consequences and the multiple objectives those consequences realise.

The main assumption embodied in decision theory is that decision-makers wish to take coherent decisions and not deliberately take ones that contradict each other. The theory expands on this notion of coherence, or consistency of preference, and proposes some simple principles of coherent preference, such as the principle of transitivity: if A is preferred to B, and B to C, then A should be preferred to C, which is a requirement if preference is to be expressed numerically. By treating these rather obvious principles as axioms it is possible to prove non-obvious theorems that are useful guides to decision-making.

Thus it is possible to establish a logical equivalence between coherent preference and number systems. If preferences are coherent, then two sorts of measures follow logically: probability and utility, both associated with the consequences of decisions. The theory establishes the existence of

probabilities: numbers that capture the likelihood that consequences will occur. It also shows the existence of utilities: numbers that express the subjective value of the consequence and the decision-maker's risk attitude.

A guide to taking decisions is also provided: choose the course of action associated with the greatest sum of probability-weighted utilities; the expected utility rule. To apply this rule, it is necessary to assess a probability and utility for each possible consequence of a course of action, multiply those two numbers together for each consequence, and add those products to give the expected utility for that course of action. The process is repeated for each course of action and the one associated with the largest expected utility chosen. Decision theory gave birth to the applied discipline of decision analysis, which has been successfully used in all aspects of organisational life.

Keeney and Raiffa extended the set of axioms so that decisions with multiple objectives could be analysed. In practice, MCDA is applied to help decision-makers develop coherent preferences. These preferences are not assumed at the start, but the approach helps groups to achieve reasonably coherent preferences within the frame of the problem at hand. Once coherent preferences are established, decisions can be taken with more confidence.

The years following the publication of Keeney and Raiffa's exposition saw increasing numbers of applications of MCDA in both private and public sectors. Its use by various governmental agencies in the United States is now widespread and the approach has also withstood challenges of its results in courts of law and inquiries. However those wishing to take very different decisions from those recommended by the analysis have not always favoured MCDA.

For projects of major public concern, '*it is crucial to obtain inputs from a variety of professionals and to have the implementation of the methodology monitored and routinely reviewed by independent experts.*' MCDA is not simply a technical process. Its successful implementation depends crucially on effective design of social processes by which the analysis is structured and conducted.

5.2 Software programs aimed at bid assessment

5.2.1 V•I•S•A Visual Interactive Sensitivity Analysis [157]

V•I•S•A is a decision support tool that helps compare alternative strategies/options against multiple criteria. Its aim is to facilitate modelling and analysis in a way that is interactive and visual, leading to improved understanding and communication, and thus better-considered decisions. Although not overtly described as a bid evaluation tool, it is clear that it is largely aimed at this task.

V•I•S•A, launched in 1988, has been used worldwide to support decision-making. It can be used to facilitate group decision-making. V•I•S•A's features include:

- Draw/change the criteria hierarchy on screen.
- No limit on size or complexity of the criteria hierarchy or the number of options/strategies.

- Interactive input of weights and scores using bar charts, linear scales or numerical inputs.
- View criteria weight and score options profiles at multiple hierarchy levels at the same time.
- Immediately see the effects of any changes on all current displays, at all hierarchy levels.
- Sensitivity graphs show the effect on options of changing the weight of a selected criterion.
- Efficiency plots display the performance of all options on two selected criteria.
- Non-linear relationships between measured scores and values.
- Ability to create model snapshots enables rapid exploration and return to different scenarios.
- Incorporation of visual images of options to act as an aide-memoire and help discussion.

Groupware V•I•S•A enables groups to each enter their own values/weights and then review the groups' views over a local area network – immediately showing where there is consensus and where more negotiation is required. DEA V•I•S•A uses 'Data Envelopment Analysis' technology that automatically adjusts weights to show selected options in the best light. This enables rapid review of alternatives so that obviously dominated options can be removed from investigation and focused discussion can be promoted about appropriate weights. Figure 41 provides an overview of some of the facilities the program provides.

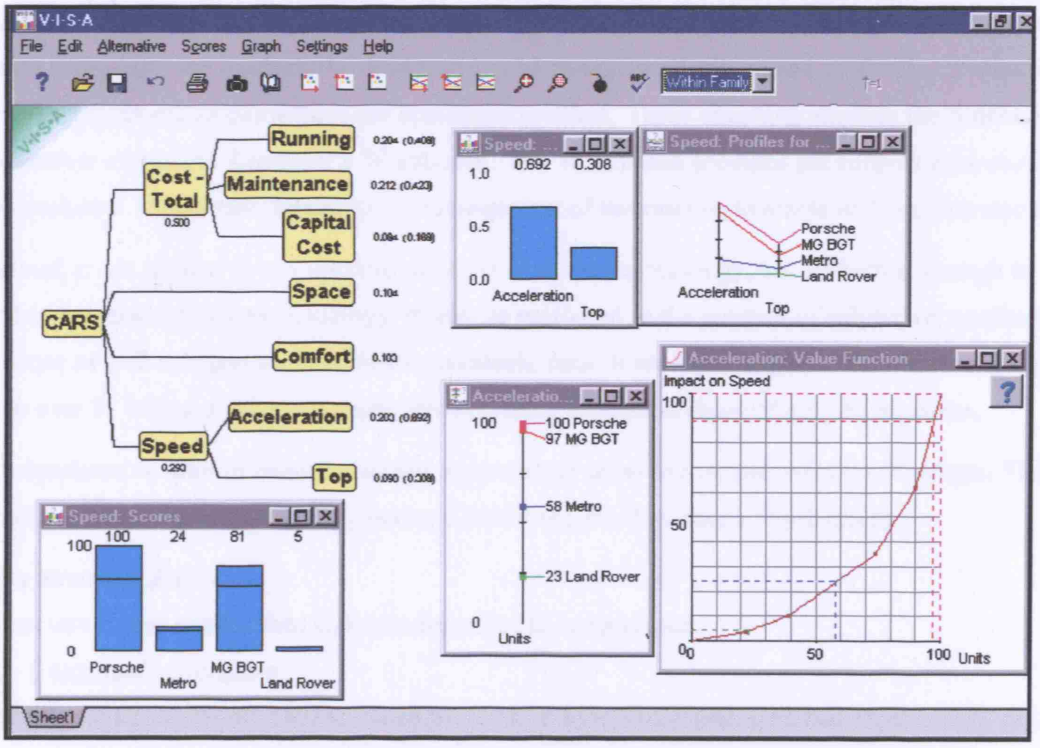


Figure 41 The V•I•S•A software showing a criterion hierarchy together with scores, weights and weighted scores for the speed criterion and its sub-criteria.

For each criterion, there is a dialogue box that allows scores and weights to be set as well as a memo facility for making notes.

Figure 42 The V•I•S•A dialogue box that enables weights to be set and scores to be viewed.

5.2.2 Tendeval [158]

Tendeval is a Windows-based program suitable for multi-user evaluation of tenders for complex items such as defence equipment. It is a flexible package designed to provide thorough, consistent, manageable and efficient tender evaluation. It includes an evaluation framework with data management services, allowing evaluators to focus on assessment. It comprises two packages; the Structure Editor and the Evaluator's Workbench. The Structure Editor is used to develop Evaluation Breakdown Structures to decompose the evaluation problem. These structures provide the framework for evaluation within the Evaluator's Workbench. The Workbench provides the support environment for the evaluator. It facilitates access to and management of information to assess and evaluate results.

Tendeval is not aligned to any specific tender-evaluation methodology, but is flexible enough to be applied to any desired user methodology. It may be employed in the conduct of subjective, qualitative evaluations as well as rigorous, quantitative, auditable ones. It has been used in evaluations ranging in value to over $1 billion and by geographically-dispersed evaluation teams of over 50 members.

A comprehensive tutorial manual contains screen shots of all the various relevant Windows. There are similar quality user guides for the Structure Editor and the Evaluator's Work-bench.

1 The Structure Editor

The Structure Editor enables four different structures to be employed.

1. Compliance Structures

   Compliance structures are used to assess the level of compliance with specified requirements of the supplier's tender or proposal. Compliance structures contain the purchaser's stated requirements, against which the supplier's offer will be assessed and provide the mechanism for verifying each supplier's intentions with respect to all the stated purchaser's requirements. The requirement can be

set to show whether up to ten parameters are, for example, Essential, Highly Desirable, Desirable or Not Scored.

2. Benefit Structures

Benefit structures are used to assess the level of benefit to be delivered to the end-users and other stakeholders by a supplier's tender or proposal. Benefit structures contain descriptions of the beneficial aspects required. Up to ten benefits can be defined as, for example, Extreme Importance, Very Important, Important, Low Importance or Not Important.

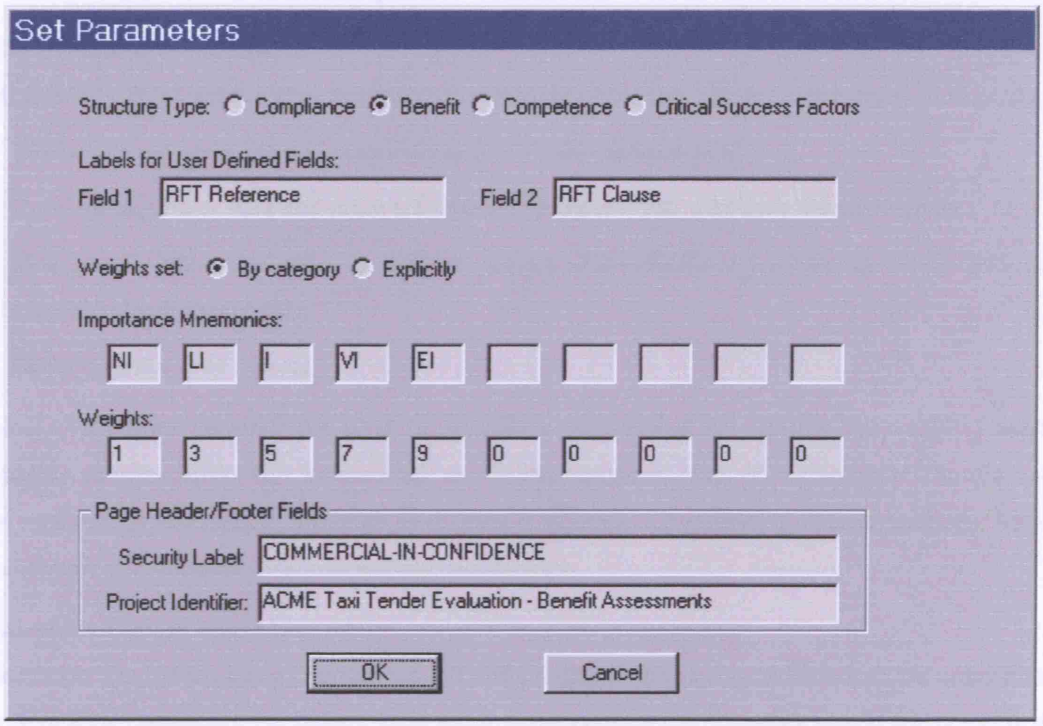


Figure 43 Tendeval screen shot showing completed parameter settings for benefit structure.

3. Competence Structures

Competence structures are used to assess the proficiency of the supplier. These focus upon capability, experience, organisational maturity, processes and plans. Competence does not provide residual benefit, but indicates the likelihood of successful delivery of the benefits offered. A maximum of ten competence levels can be scored as, for example, Extremely Important, Very Important, Important, Unimportant or Not Scored.

4. Critical Success Factors Structures

Critical success factors structures provide a mechanism for developing a top-level perspective of the tender, complementing the bottom-up approach used in the other breakdown structures. This approach provides a valuable means of verification through the assessment of the tender as whole against key factors critical to success. As many as ten critical success factors are rated as, for example, Very Important, Important or Low Importance.

Weights can be set for each parameter by one of two methods:

- *By category* – where the weight for an entry within the structure is automatically derived from the weighting aligned with its importance setting.
- *Explicitly* – where the weight for an entry is explicitly supplied by user entry. This is useful where weightings are determined using a mechanism external to Tendeval.

Weighting factors need to be set out in a weighted structure tree for later evaluation so that the weights for any particular branch add up to 1.

2 The Evaluator's Workbench

The Evaluator's Workbench is the more extensively used of the two Tendeval programs. It is used to:

- Assess offered and expected compliance, benefit and competence.
- Draw on capability data and other information to build a risk catalogue for each tender.
- Manage an issue catalogue to support project management by recording issues and their resultant closure/resolution.
- Generate a range of reports.

Typical evaluations consider the level of an offer's compliance, or possibly the value or benefit provided by an offer. Risks will be assessed, as will the suppliers' level of competence. There are two typical methods of assessment, although evaluation is possible using aspects of both methods, backed by assessment of competence and critical-success factors.

3 Compliance Assessment Method

This method of assessment requires that the ITT fully defines what is sought including the competency of the would-be contractor. An offer's level of compliance with the requirement and the level of risk provide an indication of the value of the offer. The analysis of best value for money is essentially a comparison of respective values of a set of offers, against their respective overall costs.

Assessment examines the level of compliance offered against each stated requirement, which may be of differing levels of importance. Consideration of risk enables determination of the expected level of compliance to be delivered. Tallies of compliances, partial compliances, and non-compliances lead to a determination of the value of the offer, backed by a narrative of major issues and risks.

4 Benefit Assessment Method

This assessment method centres on the concept of benefits delivered by an offer. Benefits constitute the value to the buyer of what is being acquired. In addition, there is the need to meet contract terms and the competency of suppliers to provide these benefits. These other requirements, while important, do not provide direct value but contribute to value through their influence on the delivered benefits. Fundamentally, the methodology is one of assessing the expected benefits of the respective offers, and considering the results against the respective overall costs. Benefit assessment may be based on a

qualitative-assessment system, or a numerical-scoring system, or both, with qualitative assessments underpinned by overall scored ratings. Consideration is given what is offered and, given risk, what is likely to be delivered.

Benefit assessment is based on considering, for each evaluation element, what has been requested and upper and lower benchmarks. Benefit scores are recorded using the scale 0.0 – 10.0. A single score is recorded for what has been offered by a bidder. Then a range of three scores is entered against what is expected to be delivered. Of these three scores, the 'best estimate' score is the prime figure, whilst the 'low' and 'high' estimate reflect the level of uncertainty.

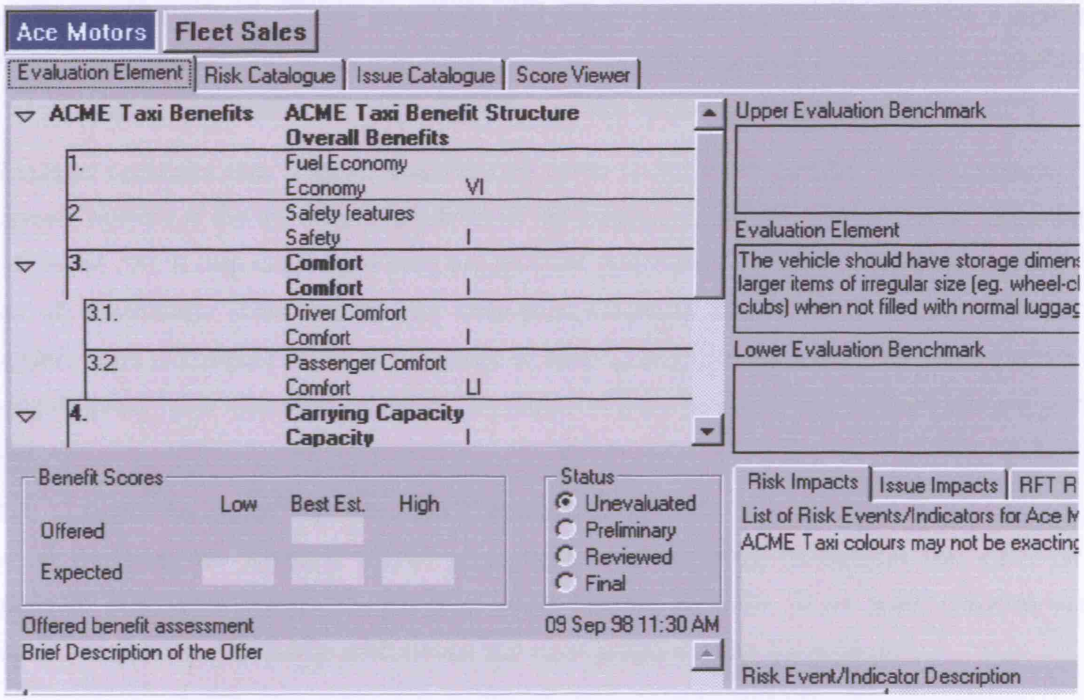


Figure 44 The Evaluator's Workbench for benefit assessment showing four areas of benefit.

Tendeval also contains four useful definitions:

Benefit – The usefulness of the supplies or services offered for delivery, within the context of what is required to be delivered.

Competence – The capability and skill of a supplier to perform the stated functions included within the offer.

Critical Success Factor – A key factor, which is critical to success. Failure to satisfy a critical success factor would preclude a successful outcome.

Evaluation Breakdown Structure – A tree structure, which represents an assembly of factors to be assessed during an evaluation. This breakdown should be structured in a logical and hierarchical manner, with branches representing various aspects, facets, or categories to be considered, and with

the actual elements to be evaluated at the lowest level. The structure may represent the complete set of what is to be evaluated, or might only represent a subset of what is to be evaluated in total. In the latter case, a number of Breakdown Structures would be applied to the total evaluation.

5 Comment

The Tendeval compliance assessment method is clearly unsuitable for evaluating tenders submitted in response to a capability requirement, as the ITT is unlikely to define fully exactly what is sought. The benefits assessment method looks much more promising. The difficulty lies in the comparative evaluation. Consider the requirement for a capability to kill enemy submarines. Three bids are received; one for a 'hunter killer' submarine, one for an ASW frigate and the third for a maritime reconnaissance aircraft. The prices can readily be compared, but comparing the benefits of the three solutions, and the additional capabilities each offers, would require the 'Wisdom of Solomon'.

Tendeval concludes that '*Benefits constitute the value to the buyer of what is being acquired.*' It measures benefits at the lowest possible level of the breakdown structure by effectively assigning a mark out of 100. It then totals the overall benefit score with 'low' and 'high' estimates reflecting the level of uncertainty. (This matches the three-point estimates carried out by MoD). Thus it is straightforward to compare the value for money of offers giving identical value with varying prices or giving different value with identical prices. A problem still occurs when both value scores and prices differ.

5.2.3 Logical Decisions(R) for Windows™ Version 5.1 [159]

Logical Decisions for Windows (LDW) is a program for evaluating alternatives that differ on a number of evaluation criteria. The program works best for decisions where many concerns need consideration at once, and where professional and value judgments play a crucial role.

LDW allows a description of alternatives with quantitative or qualitative measures. The measures can be numerical or text variables that capture some quality of the alternatives and can be anything that helps to distinguish between the alternatives. Each alternative has a raw score (called a level) for each measure. Alternatives are ranked using judgments and preferences. To review preferences for the measures, individuals are guided through a series of questions. Based on the answers, a formula that ranks the alternatives is constructed. In summary, LDW allows the following steps to be completed:

- Define a set of alternatives to be ranked.
- Define measures to describe the alternatives.
- Enter the level on each measure for each alternative.
- Review preferences so the measure levels can be combined.
- Rank the alternatives and choose the best one.

The program uses powerful methods from the field of Decision Analysis to help evaluate alternatives and is based on the principles of Multi-Attribute Utility Theory.

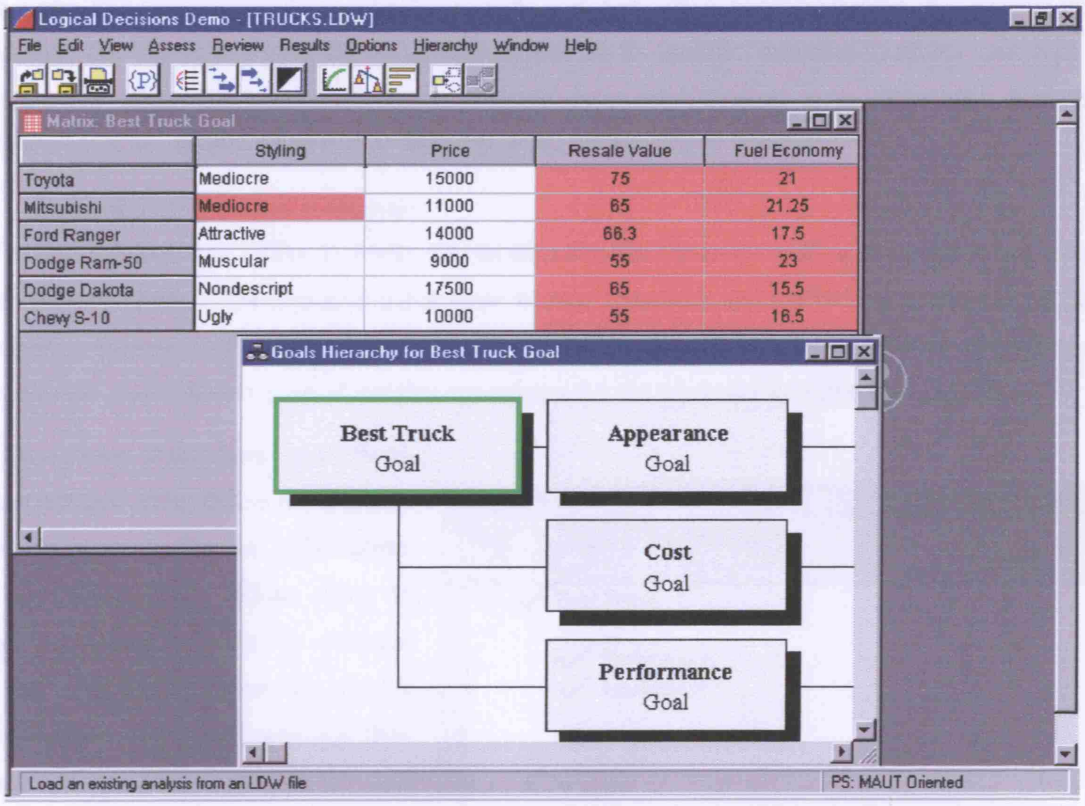


Figure 45 LDW screenshot showing goals hierarchy and scoring.

1 Defining Alternatives and Measures

While there is flexibility in the order of work, an analysis normally starts by identifying alternatives. An alternative is defined by name and level on the measures in a data matrix. Measures are the variables used to describe and then rank the alternatives. They are characteristics or attributes of the alternatives that have been made specific and that vary enough between the alternatives to influence the alternatives' desirability. Measures are defined in a data matrix or a hierarchy of goals and measures as shown in Figure 45.

After defining a measure, its level is entered for each alternative. The level is the alternative's raw score or value for the measure. Each alternative has a level on each measure. The levels can be either numbers or brief text descriptions (e.g. 'High', 'Medium', or 'Low').

2 Entering the Levels of the Measures

Measure levels in the matrix window are entered as a number or by selecting from a list of possibilities for measures that use text labels. Measure levels can also be defined in terms of any of six probability distributions.

3 *Goals*

Related measures can be grouped under a goal. This allows concerns about a decision to be organised in a way that relates overall concerns (choose the best contractor), to more specific intermediate goals (choose the contractor with the most experience) or to specific measures (number and type of contracts). Goals and measures can be grouped under more general goals, forming a hierarchy. Alternatives can be ranked by any of the goals or measures already defined.

4 *Reviewing Preferences (Weights)*

To combine the levels of the measures into an overall score for an alternative, the relative importance of different levels of the measures needs to be known. Questions about relative importance (weights) require judgments that do not usually have a single correct answer. A systematic review of preferences and values helps identify a set of weights appropriate for the particular decision being analysed.

Reviewing preferences is a three-step process. First, define a preference set to store preference information. Then (optionally) define how to convert measure levels to common units, and finally define the relative importance of the measures and their interactions. Several Preference Sets can be defined for the same decision, to show the effect of different points of view on the ranking of the alternatives. The following paragraphs describe some of the methods for capturing preferences.

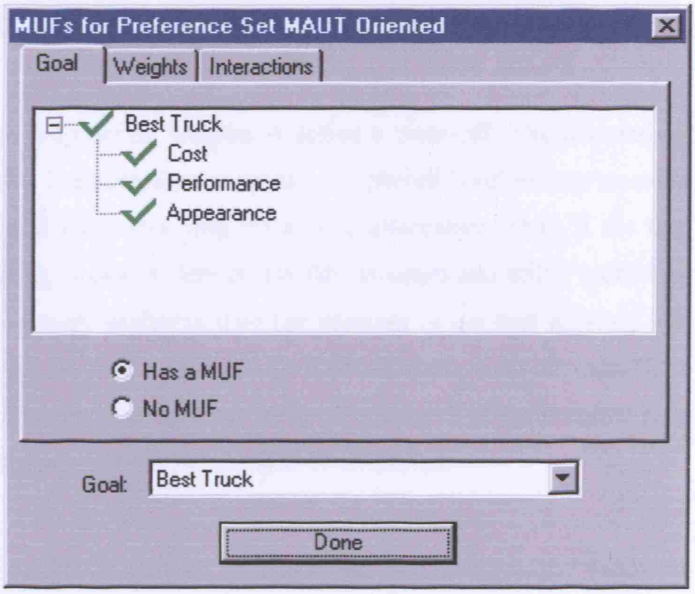


Figure 46 The LDW window used for setting weights against individual goals.

Converting Measures to Common Units

LDW converts the levels on the measures to common units before combining them. The common units are called utilities. Each measure's most preferred level is assigned a utility of 1 and each measure's least preferred level a utility of 0. Intermediate levels are assigned using a Single-measure Utility Function (SUF). The shape of the function represents a set of preference judgments about the relative desirability of different levels on the measure.

The easiest way to convert levels to common units is with a straight line, where each unit change in a measure results in an equal change in utility. When a linear conversion is inappropriate, an Assess Common Units option may be used to define a non-linear SUF curve conversion. Several other options

are provided in addition to the SUF method for converting to common units. Some are based on the 'Analytic Hierarchy Process'. The options enable direct comparison between the alternatives' utilities.

Defining the Relative Importance of Measures

Each alternative's overall desirability is described by a number, called its overall utility. An alternative's overall utility is computed by combining each individual measure's utility using a weighted average. A more complex formula can be used if there are interactions between the measures. Each measure's weight determines how much an alternative's utility on that measure will influence its overall utility. There are several different methods for assessing weights. These range from simple to the most sophisticated methods presently available.

The simplest method computes weights based on the ordering of the measures' importance (the 'Smarter' method). Several other methods rely on entering importance ratios for the measures (the 'Smart' method and the 'Analytic Hierarchy Process'). Finally, in the 'trade-off' method, weights are indirectly computed based on 'trading off' some of one measure to get more of another.

Tradeoffs

A pair of simplified alternatives used to help define weights is called a trade-off. The alternatives highlight a trading between two measures. The first alternative has a preferred level on one measure and a less preferred level on the other, and vice-versa with the second alternative. Thus, if the first alternative were traded for the second, utility would be lost on the first measure and utility gained on the second. If the two alternatives were equally preferred then the decrease in the first measure just compensates for the increase in the second. To define a weight for each measure, a set of tradeoffs is defined, making sure that each measure appears in at least one trade-off. Features of the program help assess and review tradeoffs. Interactions between measures can also be modelled.

5 Displaying Results

There are many ways of reviewing the results of analysis. The alternatives can be ranked based on overall utility or on of any other goal or measure. The alternatives are sorted by utility and then displayed. The utilities generally range from a perfect utility of 1.0 to a lowest utility of 0.0.

Besides ranking the alternatives, bar graphs can be generated showing the utilities for different alternatives, allowing detailed comparisons between two alternatives, and analysis of the effects of changes in the relative importance of the measures. Displays can also be created that show the effects of uncertainties on the ranking results. Monte Carlo simulation is used to estimate the effects of uncertainties. The program allows display of the formulae used to generate the rankings.

6 Conclusions

LDW is a powerful tool to help analyse decision problems. It provides insights into the desirability of alternatives and logical thinking through difficult choices. After ranking alternatives and reviewing

their differences, the reasons for the ranking results should be obvious. The quality of the answers depends critically on the quality of the data input and requires care to be taken to:

- Define alternatives in detail.
- Make sure all available alternatives have been included.
- Decide which measures are most appropriate for the alternatives.
- Ensure the measures cover all the important considerations for choosing alternatives, that they are not redundant, that they can be measured for each alternative and that they are meaningful for decision-making.
- Carefully deal with trade-offs.

7 Comments on the three programs

Although V•I•S•A is described as a decision support tool, the software is relatively intuitive to use and would be suitable for use by MoD in evaluating tender submissions for major items of military equipment. It has the advantages of no limit on size or complexity of the criteria hierarchy and the ability to be used by a group of evaluators.

Tendeval appears a practical program that is well suited to assessment of tenders for major equipment by a team of evaluators. The use of compliance assessment fits the current MoD requirement to select the lowest-cost compliant bid, while the availability of the benefits assessment alternative is more suited to selecting the best value for money solution. Unfortunately, the program has recently been withdrawn from the market, although the same company provides training and consultancy in tender evaluation.

Logical Decisions also seem to be a useful package for providing a logically-valid and procedurally-efficient approach to estimating value for money, based on MAUT techniques. The program converts the levels on the measures into common units before they are combined and ranks the alternatives.

5.3 The tools already in use by MoD

The AMS recommends the following tools for use during MoD bid evaluation.[160]

5.3.1 MACE (Multi(ple)-Attribute Choice Elucidation) option assessment method [161]

The AMS document '*MACE option assessment method*' starts by stating that: '*MACE is a method for applying objective measurement to the relative merits of mutually exclusive acquisition options. Its principal application is in the assessment of bidder responses to RFIs and ITTs. Its use is discretionary, though it is a 'default' option.*' MACE has been specially tailored for the Smart Acquisition process and adapted from MCDA - Multi(ple) Criteria Decision Analysis, a well-established operational-research technique described in Section 5.2.12.

MACE transposes key issues from the requirements into logical items called criteria and a numerical worth for each one can then be derived. MACE also provides an assessment hierarchy of clearly

defined and measurable criteria to include in the RFI/ITT. Factors (e.g. technical, financial) included should be determined on a case-by-case basis.

Suppliers are objectively scored against the criteria and individual scores aggregated to produce a numerical overall-merit score for each one which are then compared, so helping the selection process.

MACE is a said to be a methodical, objective, value-adding, defendable and auditable marking method that aids decision-making. It does not always unambiguously indicate the best supplier but does provide reliable information to aid supplier selection. In response to the question: 'When do we use MACE?' The document states: *'Selection of the preferred supplier ... '*

The primary MACE application is assessing supplier offers in response to formal ITTs. The MACE assessment scheme is developed after baselining the SRD and prior to issuing an ITT. For complex acquisitions, proprietary software tools are available that incorporate the MACE methodology.

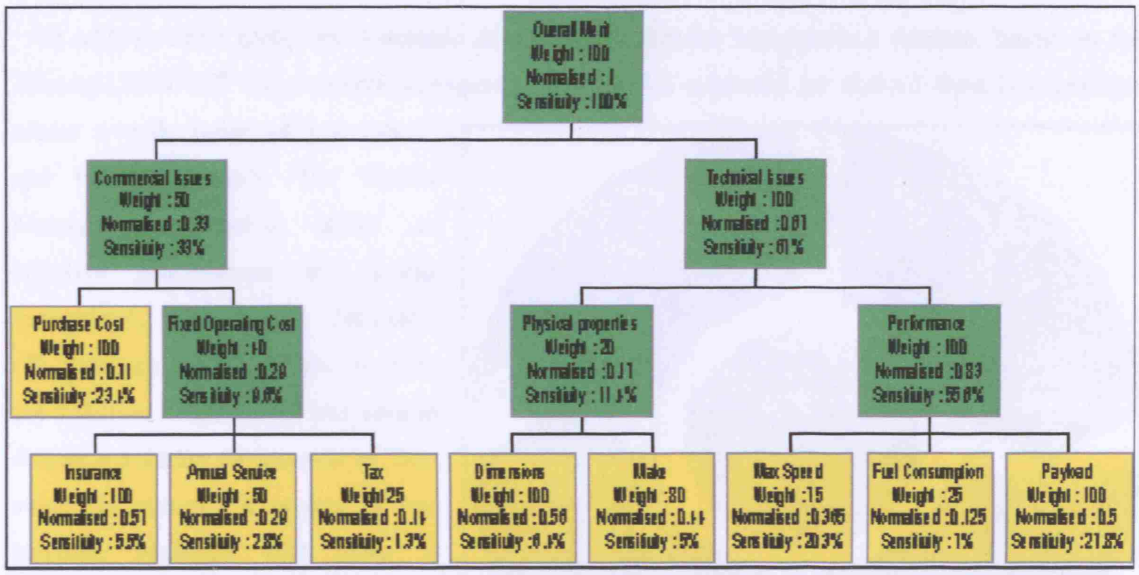


Figure 47 Example of a MACE hierarchy from the AMS MACE guidance document.

The MACE assessment hierarchy seems to break down the criteria into just two distinct groups; commercial and technical, as shown in Figure 47. The former is then broken down to deal only with cost – initial cost and COO. The technical scoring, which may be yes/no, a linear or a non-linear function or judgemental, and the commercial scores are then weighted to arrive at a merit score for each bidder. **Comment**: This is curious since the MACE output seems to give a value for money output, but without considering all relevant factors. Surely delivery, effective integration, risk and divergence from commercial terms and conditions should be added to the hierarchy.

5.3.2 Other supporting analysis methods

Various analysis methods exist to support decisions during the Concept, Assessment, and Demonstration stages of an acquisition. The main ones are:

- Decision conferencing.
- Operational analysis.
- Investment appraisal.
- Risk analysis.
- COEIA.
- MACE.
- SIBET.

5.3.3 Telelogic DOORS® Tender management (proposal evaluation)

The acquisition of complex systems or projects depends on selecting the right supplier able to deliver a compliant solution (**Comment**: this insistence on compliance is a worrying feature of MoD's acquisition procedures) against the requirements, in time and to budget. Assessment of tenders is expensive, difficult and time consuming. The large quantity of information generated is often poorly managed and not linked effectively to the decision-making process, or indeed to the requirement . Analysing and defending the decision can be as time-consuming as the assessment itself.

To address these problems, Telelogic developed the Tender Management solution, based on the Telelogic DOORS® requirements management tool, and a methodology derived from best practice across a wide range of government and industry sectors. The Tender Management solution offers an effective procurement and tender assessment process that facilitates efficient decision-making and leads to the selection of a supplier best able to deliver a solution on grounds of 'best value for money'. It is one of two software packages (the other is AWARD covered in Section 5.3.4) available for use by IPTs during tender assessment and contractor selection.

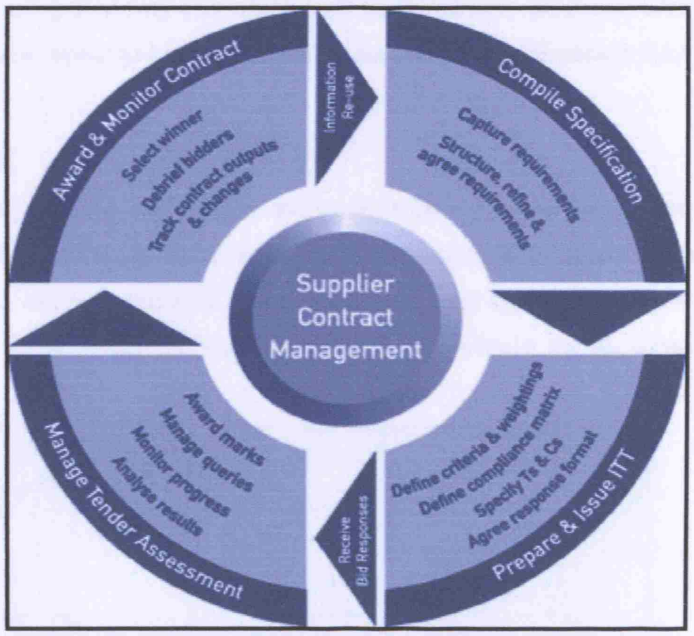


Figure 48 The four main roles of DOORS in supplier contract management; specification compilation, ITT preparation, tender assessment and contract award and monitoring.

By integrating the tender assessment and management methodology and process into DOORS, organisations are able to establish a corporate standard to manage acquisition, using an integrated solution that supports project whole-life management, throughout the supply chain.

Using DOORS/Tender Management during the assessment process helps to make selection objective, efficient, repeatable, publishable and auditable. Using the Tender Management solution, the ITT requirements, assessment criteria and proposal responses can be linked and viewed by the

selection team to ensure requirements are covered and assessment criteria are met. Additionally, the solution captures a detailed audit trail of the decision, for internal and independent scrutiny.

1 Use of Telelogic DOORS®

The Strategic Defence Review [162] concluded the ability to deploy offensive air power will be central to future force projection operations and there is a continuing need for the UK to have the capability offered by aircraft carriers. The CVF (future aircraft carrier) IPT is responsible for delivering this capability such that the optimum solution in terms of performance, time and cost through life is achieved. Consequently the CVF project is a large, high-profile programme that is tasked with delivering two affordable and capable ships into service in 2012 and 2015 respectively with an initial acquisition cost of £2.7Bn. In 2003, when the project was mid-way through the Assessment Phase of the MoD's Smart Procurement approach, two Candidate Prime Contractors were competing for entry to the Demonstration and Manufacture Phases. Working closely with Telelogic the CVF IPT developed a process supported by a specially-developed tool built on DOORS that tackled the issues surrounding the management of a robust competition between two candidate prime contractors throughout the Assessment Phase in an integrated way and which built on the already extensive CVF DOORS Database. This approach does not appear to have been entirely successful. See Section 8.7.1.4 RN CVF.

5.3.4 Commerce Decisions AWARD

AWARD is the second of two software packages available for use by IPTs during tender assessment and contractor selection. It helps acquisition project teams in the challenging process of competitive procurement of major systems, services and infrastructure. Complex procurement typically involves multiple bidders and a comprehensive set of assessment criteria, which together make the decision-making process extremely challenging.

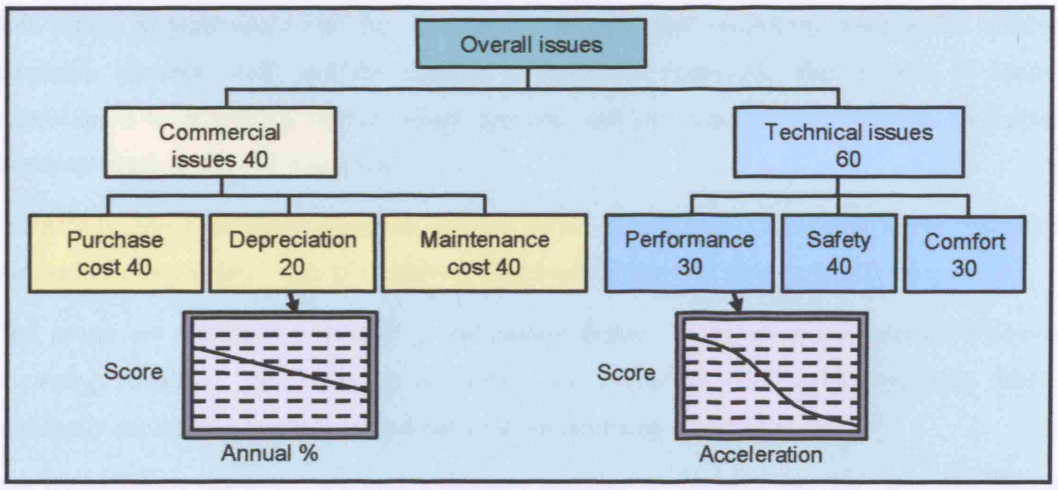


Figure 49 An AWARD example shows how the criteria to be measured may be broken down and individually weighted by the IPT. The scoring system for each criterion may be linear or non-linear.

AWARD is an intranet-based purpose-built procurement solution designed specifically for complex, high-value projects. It allows project teams to collaborate online and incorporates tools that support the entire tender assessment, negotiation and audit processes. It meets the needs of public sector procurement organisations, servicing the key stages of:

- Structuring of assessment criteria.
- Assessment and scoring of bids.
- Analysis and reporting of the results.
- Negotiation and bid improvement.
- Bidder de-briefing.
- Decision review and audit.

AWARD helps decision-makers arrive at the right choices quickly and efficiently, with features such as online management progress reports, a bid-comparison function and 'what if' analysis. It aggregates multiple scores and records rationales against every decision point and score.

5.3.5 MoD Soft Issues Bid Evaluation Tool – SIBET [163]

SIBET is a tool for evaluating soft issues such as relationship factors, culture, strategy and change management in bids produced by commercial organisations in response to invitations to negotiate from MoD. It helps to ascertain whether they have the appropriate characteristics to enter into a long-term commercial relationship. Unfortunately, its use is not mandated but is recommended primarily for a longer-term, complex and costly acquisitions, particularly where the specification is not clear at the outset and a partnering relationship is sought. It allows staff to give soft issues a value, feed this value into a modified bid-evaluation procedure and use the resulting information to make a more informed choice of commercial supplier. SIBET is an intelligent, black-box program zipped on a single disk. It runs in Microsoft Access. Its accompanying handbook suggests that the program can be used in two different scenarios. The first is at the pre-qualification stage and the second is during down-selection to an invitation to negotiate.

Soft issues become important for long-term, complex and expensive acquisitions where the relationship between MoD and the supplier is especially important. The purpose of long-term relationships is to establish a rapport where openness and trust lead to cost reductions as a result of information sharing and risk reduction.

Historically, MoD selected a particular supplier for obvious reasons. 'They gave us the best price' or 'their quality was superior'; two of a number of parameters summed up as value for money.

'Soft issues are relationship factors ... and culture factors ... and change management factors ... and strategy factors ... and ... things we believe will impact on VFM in the long-term. MoD has traditionally excluded them from consideration when awarding a contract.' [164]

Soft issues reflect the way a potential supplier's business is managed; anything that will impact on value for money in the long-term. MoD has traditionally excluded factors (like ability to work with MoD, quality of a company's industrial relations policy or innovative thinking, or perhaps their ability

to create value) from consideration when awarding a contract. In many ways, SIBET represents a baseline and a useful starting point for the development of a much more comprehensive bid-evaluation tool.

The SIBET handbook states '*SIBET is a tool for evaluating soft issues in a bid produced by a commercial organisation. It allows MoD project staff to give soft issues a value, feed this value into a modified bid-evaluation procedure and use the resulting information to make a more informed choice of commercial supplier.*' [165]

SIBET includes forty different defined issues, ranging from '*How does the potential supplier maximise capital investment for business development?*' to '*How does the potential supplier measure a supplier's performance and communicate such information to the supplier.*' For each issue, the degree of importance can be set to one of five levels: Standard, Material, Significant, Very important or Critical and a weighting value is automatically assigned to each.

For every one of the forty issues, six degrees of evidence indicator are provided, together with space for a description of the evidence presented, which will either be objective or predictive. From these data, the scores are automatically calculated and presented.

5.3.6 Comment

It seems clear that the purpose of using SIBET in selecting a bidder for a project is to reduce the risks involved with working with that contractor. Thus, soft issues have been grouped together with risks associated in providing the required capability, delivery and other factors (as well as financial risks that are part of the money side of the value for money equation).

5.3.7 Tools for Decision Group (TFD) [166]

TFD has developed analytical methods and software tools to support economic and strategic decisions that the designers, manufacturers, owners and maintainers of hardware systems, both military and non-military, are called upon to make. Although not yet in use by IPTs for bid evaluation, TFD is already in use by BAE Systems for the Eurofighter Typhoon, the RAF for resource modelling, and Lockheed Martin for the JSF. TFD comprises three programs; EDCAS, MAAP and VMetric XL. The three applications can be run in sequence, the results from one serving as inputs to another. However, as VMetric XL only deals with spares stocks, it is not considered further.

1 EDCAS

EDCAS is a life-cycle cost and level of repair model. Its interface enables analysts quickly to portray and compare alternative hardware design or acquisition options.

Figure 50 EDCAS Tools for decision software is orientated towards military users.

It can be used for any hardware decision with downstream or life cycle economic implications. Whether the system in question is a frigate, fighter aircraft, tank or radar installation, the cost-effectiveness of design and support will hinge on the appropriateness, accuracy and timeliness of the analysis brought to bear on the problem.

By giving almost immediate feedback on the life-support costs and logistic performance of design alternatives EDCAS brings logistic concerns inside the systems-engineering decision loop. It helps analysts seeking to identify cost-effective design and support strategies in the concept and development phases of the system life cycle, or to determine the relative costs of available options in the acquisition and in-service phases.

EDCAS is said to be sensitive to the cost implications of all kinds of hardware-design decisions, including both hardware and manpower aspects. Since the model is defined in terms of real economic costs and marginal cost definitions, decisions benefit from full knowledge of real costs and real savings.

Figure 51 EDCAS may be used to compare the merits of different supplier configurations.

2 MAAP

MAAP is a 'reduction of total cost of ownership' decision support model. It can be used to study the resource and cost implications of the deployment, operation and support of complex, evolving systems in dynamic operating scenarios and provides decision support in a wide range of setting. Of particular relevance here is its use in system selection. Although based on multiple criteria, selection choices should always be supported by reliable COO and resource profiles that MAAP provides. It also facilitates transmission from prospective vendors of detailed product information for timely comparative analysis. It assists in the identification of competitive in-house or outsourced maintenance, supply and management arrangements. For resource management, MAAP gives a full picture of the resource use profiles associated with system acquisition, phased introduction, operation, support and upgrade.

Figure 52 MAAP is a total cost of ownership decision-support model.

3 Comment

TFD is clearly a useful tool but can only provide some relevant data for tender analysis.

5.3.8 Conclusions on MoD models

It is clear from the description of MACE, Telelogic DOORS® Tender management (proposal evaluation), Commerce Decisions AWARD and MoD Soft Issues Bid Evaluation Tool – SIBET above, supported by DPMT Tender Assessment and Contractor Selection (TACS) one-day course described in Section 8.12.1, that there are methods of measuring the relative value of competitive bids. However, there are several factors that militate against the provision of a complete measure of value for each bid. First, it seems that not all factors get considered. Smart Acquisition's aim is 'better, faster, cheaper and more effectively integrated.' These criteria examine performance, effective integration, delivery time and price. Thus best value for money requires that the first three are maximised and the fourth is minimised.

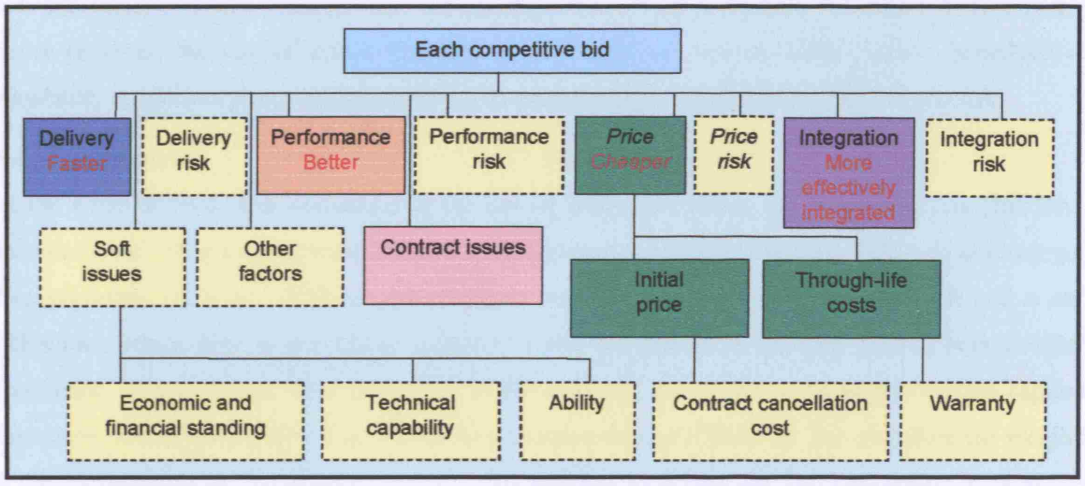


Figure 53 What is covered by 'faster, cheaper, better and more effectively integrated' in solid rectangles and, in yellow, what further considerations should be taken into account.

But what happens about risk? SIBET looks at the general ability of contractors to perform, but that is all. Should the aim be 'faster, better, cheaper and more effectively integrated – with greater certainty'? What about other factors? Is it possible to put realistic weights on such diverse factors as performance, delivery, supplier technical capability and implications for the defence industrial base? Then there is the fact that IPTs are being trained only to acquire from suppliers able to deliver a compliant solution against the requirements. Still there is the spectre of the slightly non-compliant bid that is significantly cheaper being rejected for that minor non-compliance. Furthermore, there is the warning in the AMS that '*the use of mathematical models to attempt to weave the wider factors into the COEIA is considered unwise as it could mislead the IAB and ministers into thinking that all factors have received adequate consideration.*' However, this should not prevent the use of MCDA tools to assess all the other factors included in the Business Case, in the same way that the COEIA assesses operational effectiveness. The IAB would then be presented with only two inputs; the existing COEIA and the sum of the aggregated, weighted criteria included in the Business Case.

5.4 Conclusions about models of value

The research has concentrated on the following areas:

1. Are the models/software programs detailed in Section 5.3 effective in helping MoD to measure value?
2. Are there any other models such as those in Section 5.2 that might prove to be relevant?
3. Are any of the bid-assessment software programs relevant to MoD measurement of value?

An overview of the current MoD models (DOORS and AWARD) suggests that they are effective, but their use is only discretionary. They incorporate much of the theory described in Section 5.1. They are customised to MoD needs and are thus better suited to the task of assessing the value for money of bids for major military projects than the programs described in Section 5.1 and 5.2. However, for major projects, the use of either DOORS or AWARD as well as SIBET could beneficially be mandated, the former two to improve the assessment process and the last to help reduce risk.

5.4.1 Comment

At the heart of MoD bid evaluation is the use of Multiple Criteria Decision Analysis (MCDA). It provides a way of looking at complex problems (defence acquisition certainly falls into this category), disaggregating them and dealing with multiple criteria. MCDA is both an approach and a set of techniques, which aims to provide an overall ordering of options, in this case placing bids in order of preference. Major bids to MoD will differ in the extent to which they achieve the various capability objectives, and none is likely clearly to be best in achieving all objectives. It is therefore the weighting of the various criteria that is both crucial to the ordering of objectives yet problematic to implement. What are the relative values of very diverse factors ranging from performance to UK employment? MoD while grasping MCDA for the operational evaluation part of COEIAs, separates the factors considered in the COEIA from those found in the Business Case and rightly insists that no attempt is made to weave the excluded criteria into COEIAs. The issue is the benefit of employing MCDA to evaluate the factors in the Business Case. The use of this approach to Business Cases might make the weighting task harder but should reduce the difficulty for the IAB of establishing the overall order of bids. By using computer software, it should also reduce reliance on personal intuition in the decision-making process.

6 VALUE IN THE MoD – MSc DEFENCE SYSTEMS ENGINEERING DISSERTATION [167]

6.1 Introduction

Each student who attended the UCL DEG MSc course had to complete a personal project. The author of this thesis proposed an assignment entitled '*How IPTs assess best value bids.*' He supervised the project and its contents have been used to contribute to this thesis. The purpose was to obtain an insight into the way in which key individuals think about value within IPTs. The stated project aim was:

> *To understand the process actually used by IPTs in assessing the value of bids submitted in response to calls for tenders and the way in which recommendations are made to the IAB for approval. This process will then be compared with that recommended in Smart Acquisition's AMS. The project will include examining the value part of 'value for money', but not the monetary aspects.*[168]

The dissertation concludes that:

1. IPTs see value as a combination of performance, time and cost (PCT) parameters [pp] and that Smart Acquisition principles are well understood.
2. Overall acquisition policy is scattered throughout a number of documents and often staff involved in a tender process have no clear knowledge of the entire process end-to-end.
3. The DPA/DLO split continues in the distribution and use of policy and guidance with much less importance being attached to it by DLO staff.
4. IPTs use the tender (and contractual) process intelligently and are learning how different strategies work for different acquisitions projects.
5. Risk is still an area where greater and earlier work is required in a project. However there is no indication or guidance for measuring risk as a value. Current guidance only identifies approval of lower levels of risk within the agreed performance, cost and time envelope.

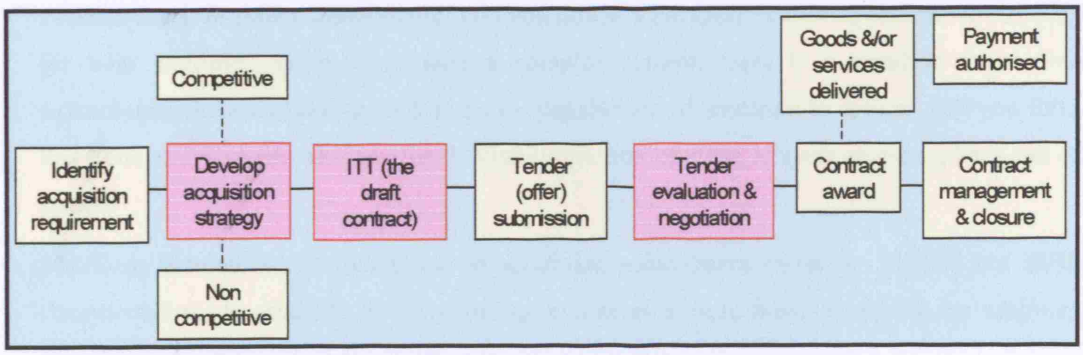


Figure 54 Value decision points in the contract process.[169]

[pp] At this stage, effective integration had only just been added to the PCT envelope.

6.2 Research

6.2.1 Background

Whenever value is discussed most people unconsciously relate to it in financial terms. For the dissertation, value is defined as the worth in usefulness or importance to the possessor and thus when assessing tenders, what worth do they have for MoD, do they meet the requirements and will they meet the military capability gap within the required PCT envelope?

Due to the skewed definition of value, IPTs were asked how they define value and how they assess value when examining tenders. Research focussed on IPTs undertaking large, complicated projects. Research was also carried out on IPTs attitude to risk and how they view risk when assessing of value.

6.2.2 Questionnaire

A questionnaire '*Examining non-monetary value and decision-making in procuring complex defence systems*' (included as Appendix 1) was sent to IPTs. Although the research aimed only to examine value some questions did involve money. This was mainly to challenge the common perception that value assessments are ignored in favour of choosing the cheapest bid. The questionnaire covered six topics:

1. **Value:** the aim was to gain a view of what IPTs consider value to be.
   – What do you define value as (please rank in order)? Timely provision of equipment, minimised risk, reduced through-life costs, increased availability, operational effectiveness, minimised support, increased technical capability or other.
2. **Tender Assessment:** The purpose was to examine how IPTs follow the process and toolsets defined in the Commercial Awareness Guide. In some areas, early down selection of technologies was occurring and thus tender assessments were becoming more of a soft issue examining contractors' capability to deliver to time and cost.
   – Did you utilise the default MoD toolsets for tender assessment? How did they help/hinder you in the decision-making role? If you did not utilise the default MoD toolsets what guidance/process did you implement? Do the MoD/Defence Industry published Codes of Best Practice assist in tender assessments? Did you utilise a Pre Qualification Questionnaire and if so for what purpose? When examining a complex system, there is a trend to down select technologies early and assess tenders on the capabilities of tenderers to deliver. Did you follow this trend and if so for what purpose? What proportion of effort is spent assessing hard and soft issues?
3. **Marking Schemes:** The intent was to scrutinize some issues raised in MACE and SIBET documentation, to establish how weightings and scoring were being produced, by whom and how the requirements documentation was utilised for this.
   – What functional areas were included in producing the weightings? How are the final weightings decided upon? When deciding the final weightings was bias accounted for? Did the

weightings allocated utilise the priority schemes for capability identified in the requirements documentation? Did weightings reflect priority of requirements coupled with difficulty to achieve? Did you only accept compliant bids? If no at what level would a bid be rejected? Were non-compliant alternatives bids considered?

4. **Auditing:** How IPTs undertake and audit the process.
   – Should an audit trail be maintained for deciding on the tender process to be undertaken? How did you maintain an audit path throughout the tender assessment? Did all staff assess all tenders? Were there any staff changes during the tendering process?

5. **Decision-Making:** How value assessments are used to make the final decision.
   – When performing a tender assessment what priority level do you place on value in the decision-making role, in relation to using monetary value in decision-making? How did the best value selection relate to the commercial/cost selection? Was the best value selection the solution chosen? What priority is placed on the level of risk in a project and how is this utilised in the decision-making process? Did you undertake a red team review on the decision? Would a red team review add value to the decision-making process?

6. **Personal profile:** This was gathered for statistical purposes only covering age, employing branch, grade/rank, time in IPT and functional area.

6.2.3 Interviews

Questionnaires were sent to IPTs to complete prior to an interview. The interview then became a discussion of the answers given with project background information added as required e.g. to discuss acquisition strategies.

6.2.4 Bias

The research being carried out was limited to a number of IPTs; therefore there was a clear chance of bias in the results occurring. IPTs were selected, with the DPA Commercial Support Group assistance, from a number of areas detailed in the following table and a wide range of values from the lower end of Category C projects (£25m to £35m) up to Category A projects (> £1Bn).

Acquisition Areas researched	
Weapons platforms	Support contracts
Tri-service communications systems	Naval platforms
Service provision contracts	Non-equipment contracts

The review of bias included the use of a questionnaire and some use of suggestive answers, which was resolved by undertaking interviews, and noted the high ratio of people with a commercial background. The IPTs addressed were mainly those that have gone through the tender process and have performed their assessment, one IPT, currently at the start of the tendering process, was included.

6.2.5 Research results

The results of the research came in both the responses to the questionnaire and notes of the interviews. The computer program SPSS was used to analyse the responses to the questionnaire, providing the ability to cluster results together, so that sets of answers for the different functional areas could be viewed. When multiple options were available for an answer, the scores used a linear scale: the highest-ranking answer getting 8 points, the least important 1 point.

6.3 Analysis

6.3.1 Statistical Profiles

The questionnaire was produced to be anonymous but did provide a section to gain an insight into those completing the questionnaire. The functional areas were mainly commercial and technical but there was representation from an IPTL, requirements staff and support staff. The spread of grades went from band D – B although the majority of staff was in band C.

6.3.2 Value

The main responses from the IPTs were in three areas, reduced through-life costs, timely provision of equipment and operational effectiveness. It is unsurprising that reduced through-life costs, one of the fundamental concepts behind Smart Acquisition, is seen as most important. It is clear that the concepts of performance, cost and time (the three trade-off parameters) are what people look for as value.

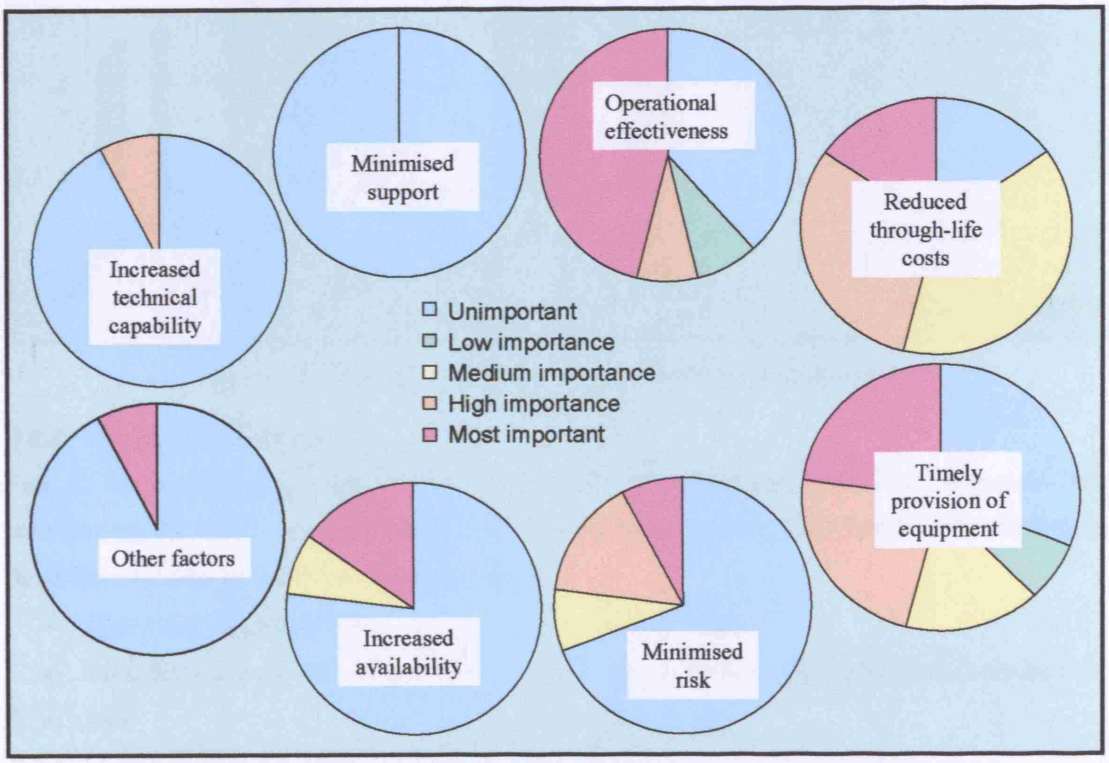


Figure 55 A summary of the relative importance of the various value factors. Most important is indicated by the red end of the spectrum and least important by the blue end.

No respondent mentioned the recently introduced concept of more-effective integration. This could be seen as an indication that integration is not as important a factor in considering value or more likely the concept is not being publicised effectively enough throughout IPTs.

All functional areas see value as a combination of performance, cost and time with each area having different priorities. In the commercial area, operational effectiveness is least important (almost matched by increased availability). With the commercial response being the most numerous it is perhaps why operational effectiveness comes in at third place.

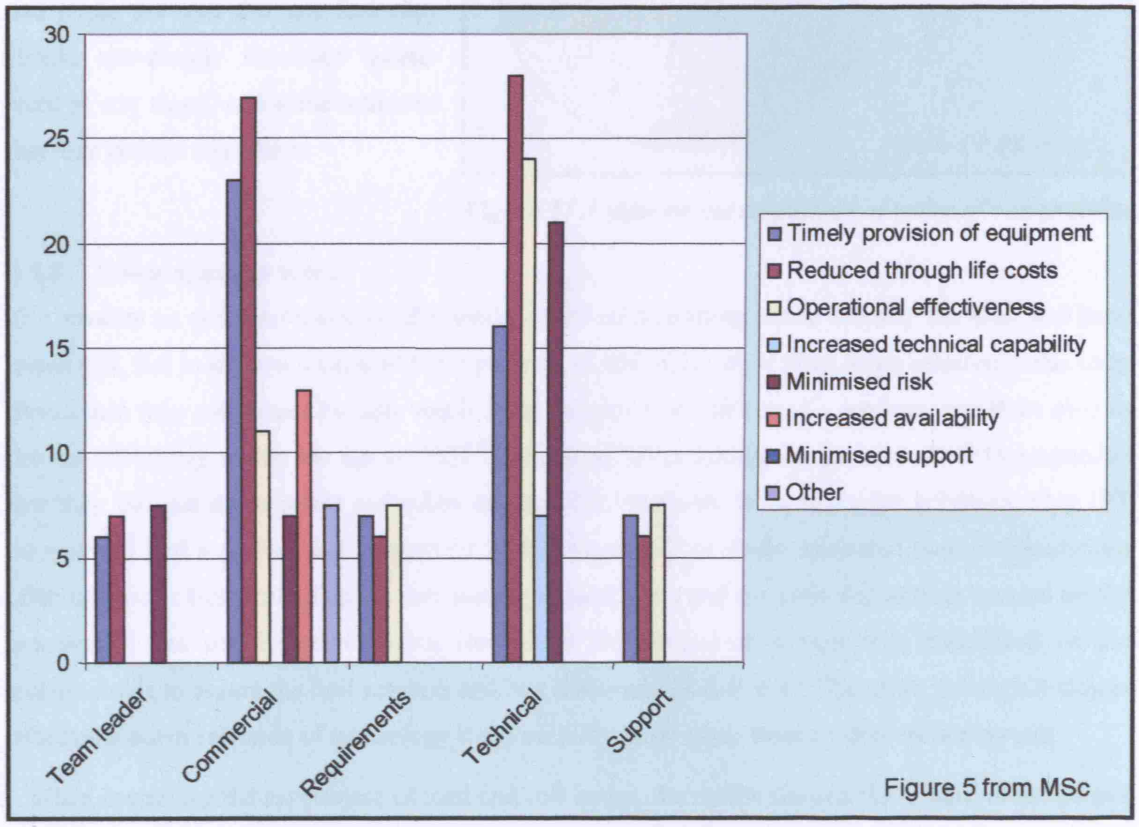


Figure 56 Views of 'value' vary depending on the functional area.

6.3.3 Acquisition strategies

Part of the acquisition process is the development of appropriate acquisition strategies. When interviewing the IPTs it was apparent that different strategies had been developed. The following lists the different strategies that were being utilised.

- Conventional competition.
- Modified conventional competition.
- PFI.
- Single source.
- Single source with Public Sector Comparator.
- Alliancing.

6.3.4 Defence/industry policy and codes of best practice

The results from asking if the codes of best practice assisted tender assessments gave a confusing picture. The codes (and the subsequent policy) aim to have an open and honest relationship ensuring

that MoD can clearly identify requirements and provide a fair competition whilst industry can make MoD aware of the realism of technologies and have sight of how tenders will be assessed.

There was a big spread of answers and at the interviews the reason for this was because some IPTs were not fully aware of what the codes contained. Some felt they were just motherhood and apple pie and did not feel they should specifically influence assessment at any stage, and some admitted that they had not read them.

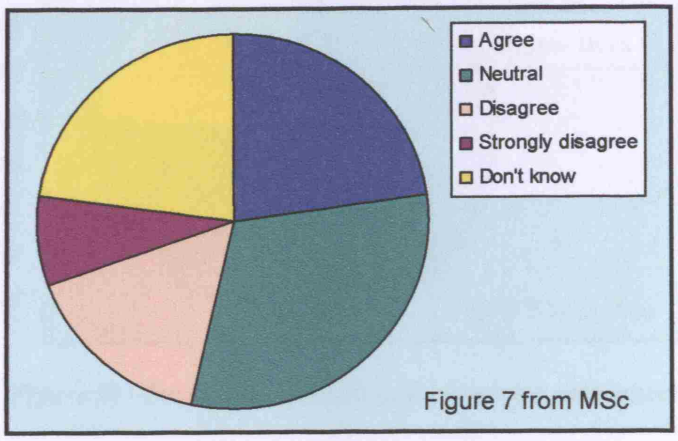


Figure 57 A view on the usefulness of codes of best practice

6.3.5 Down-selection trend

The answers on down-selection trend provided quite an interesting result. Initially the issue had been raised that, due to the complexity of some projects, technologies were often down selected in the early phases and then soft issues became much more important to confirm if a tenderer would be able to deliver effectively within the agreed PCT boundaries. When asking the question all IPTs responded that they did not down select and often felt that this might tie them into poor solutions. One IPT interviewed had a project that seemed to fit this possibility of down selection; two tenderers were offering similar technical solutions that met the requirements and the main discussions centred on the commercial and soft issues. However throughout the assessment a view was maintained on the technical side to ensure the best solution and best cost could be delivered. Therefore although it almost reflected a down selection of technology it did not fully move away from a technical assessment.

When examining the assessment of hard and soft issues, the results showed that a third of the people indicated a combination of hard and soft issues. Where soft issues were more important (over 50%) again it seems as if the down-selection trend is being followed. However the IPTs still indicated that even in cases where the hard issues were not as important they were still being examined to ensure situations such as innovative solutions were not lost.

6.3.6 Use of toolsets

The majority of IPTs utilised the toolsets available. The toolsets were not used as readily in DLO although this was due to the types of acquisition process being undertaken. Within DPA only one IPT did not utilise the toolsets and again this was a reflection of the acquisition strategy (a single source contract not requiring a conventional tender assessment). In this instance the IPT was performing a single-source tender process and were utilising expert knowledge from commercial staff.

As Figure 58 shows, of the IPTs that used the toolsets over half found them helpful and in some of the IPTs that stated that they felt they neither helped nor hindered, it transpired that they had produced their own assessment scheme as a derivative of the MACE methodology. In these situations it could be said that the toolsets were useful in the production of the final assessment scheme.

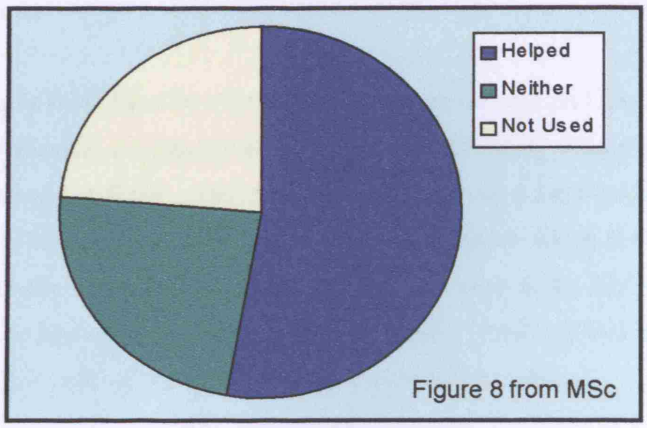


Figure 58 - Do the default MoD toolsets provide assistance?

6.3.7 Weighting and scoring schemes

The research undertaken did not aim to detail weighting/scoring schemes utilised but instead was interested in how they were produced and how bias was considered; did all the functional areas get an input on the weightings and how were decisions made. The results show that any weighting scheme included all areas though the technical and commercial ones have the largest input.

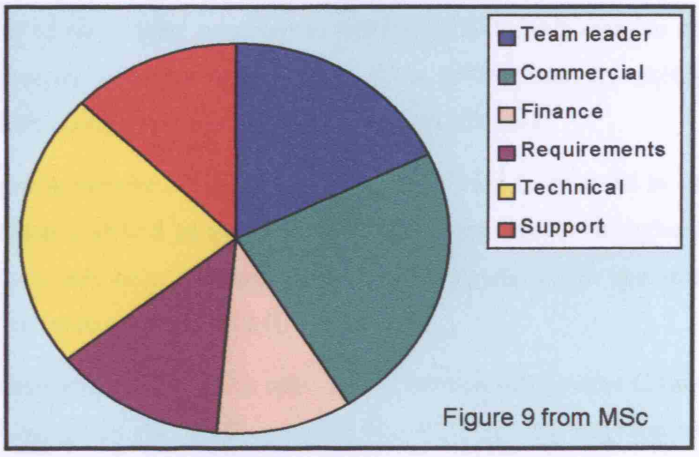


Figure 59 Functional areas involved in producing marking schemes.

Around one third of the IPTs questioned feel that bias isn't taken into account during the production of weighting and scoring schemes, with less than a quarter thinking that it is. This is shown clearly in Figure 60.

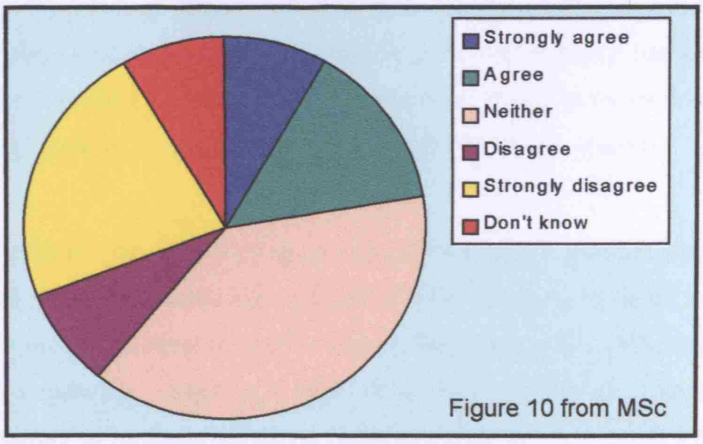


Figure 60 Is bias accounted for in weighting and assessment schemes

6.4 Conclusions and recommendations

6.4.1 Value

From the research and analysis, 'value' is seen by IPTs to be a function of performance, cost and time. Excluding any monetary interest it can be assessed as operational effectiveness with timely delivery. This shows that the Smart Acquisition message of faster, cheaper, better, although not always more effectively integrated, is getting through and acquisition staff are aware of the criteria on which they should be measuring bids. The view was broadly the same for all IPTs with the exception of the DLO-hosted IPTs. Here there was a distinct bias to both support and increased availability. However this is in place of timely delivery since from the DLO point of view the equipment is already in service.

6.4.2 Policy information

The AMS is intended to be a 'one stop shop' for acquisition information and is always the place most people involved in acquisition will visit first. As was anticipated (by both the project sponsors and the dissertation author) there is no guidance on tender assessment in any obvious position in the AMS. Direction is included (or at least a link to the correct location) to enable the following areas to be retrieved for perusal: commercial guidance, codes of best practice (plus defence/industry policy documents), and toolset documentation and guidance for producing assessment schemes.

One conclusion is that people involved in acquisition are not fully aware of what is involved in an end-to-end tender process nor what guidance should be read and used. There are experts throughout the acquisition system but often they have only been involved (or have good knowledge) in one area of the process, be that creating acquisition strategy or assessing tenders.

A final issue with the policy information is the DPA - DLO split. DPA Commercial Services Group provides commercial policy information across the MoD but with the AMS as the information repository there are a few problems with distributing this information. The DLO, being 'service' led, seems to view the AMS more as a DPA reference library, which is where it started life. However Smart Acquisition is just that, acquisition not procurement, but it would seem the evolution has not reached the DLO. In these cases it is more likely that previous experience is going to be used or Commercial Services Group will be employed as a form of help desk to get the latest information.

6.4.3 Processes

At the start of the acquisition process each IPT needs to develop its acquisition strategy. Because each IPT is dealing with a different requirement, their strategies will differ. This variation needs to be maintained to ensure that the best form of acquisition is used to match the requirement. Open and honest competition is a bedrock of acquisition. However if there is a reason not to go with a conventional competition (as often appears to be the case) then as long as the decision is justifiable and is available for industry scrutiny, and openness and honesty are maintained, then the principles of Smart Acquisition can be followed hopefully culminating in a faster, cheaper and better solution.

Lessons are continuously being learned. An IPT, which is currently moving through the acquisition process and aiming to undertake Smart Partnering (or alliancing), is taking the partnering concept but improving it based upon what has been learnt from previous partnerings.

The down selection [qq] trend does not seem to be being implemented and some IPTs appear to have no reason for this. In the earlier stages of the CADMID cycle, technology is being examined from a risk reduction point of view through the implementation of technology demonstrators and other work. With all this effort being put in place early in the acquisition process it makes sense to utilise it for decision-making and then focus on the soft issues to confirm industry's ability to deliver. By removing the focus of technology it is possible to reduce the time spent in assessments moving towards a 'faster' process. It is understood that some IPTs will maintain technology as an issue to ensure it keeps industry alert and make sure all technical options remain open. In some cases this may be reasonable but serious thought should be given to securing the technical solution early.

IPTs are on the whole aware of the available toolsets and find them of use. They help to set up the weighting and scoring schemes and provide a defensible form of assessment that can be shown to industry. Following the Gordon Foxley [rr] affair, teams make decisions as a group and no longer should any one person have the final say on a decision. Being fully audited suggests that in all cases acquisition staff can be confident the correct decision was made.

Risk continues to be an important factor in any acquisition requirement. People are aware of its importance although it appears that sufficient money is still not spent early enough to achieve the benefits expected; a lesson that seems hard to learn. However there is one area on which focus is needed. Risk is not viewed as a form of value and IPTs appear uninterested in accepting riskier solutions for capital reductions. As long as three-point estimates fall within approval limits, then IPTs will be content. This is compounded by the fact that often bids will either be greatly different in price with no great difference in capability, or similar in price but with capability greatly differing from bid to bid. It would be interesting to see the decision made when unproven technology is presented at reduced cost.

Finally the majority of acquisition staff see value as more important than cost and that even if this attitude is used throughout the assessment process, the 'best value' solution still seems to be either the cheapest solution or at least broadly similar in price to it. Possibly this is happening because of the more open and honest relationships occurring between MoD and industry. This should ensure that

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[qq] The AMS states 'Studies and Technology Demonstrator Programmes generate the hard evidence of technology maturity. At the early stages of the CADMID cycle they can be used to de-risk novel technologies to enable them to be considered alongside other less risky options. During assessment and demonstration they provide the hard evidence to support technology readiness level assessment and enable down selection of options'. http://www.ams.mod.uk/ams/content/topics/2622.htm accessed 25 Apr 05

[rr] Identified procurement fraud. See Hansard Tuesday 6 June 1995.

industry has sufficient data to provide suitable tenders that can deliver the right capability and stand a good chance of winning; a good advertisement for the Codes of Best Practice.

6.4.4 Where now?

The fundamental problem encountered in tender assessment was the distributed guidance and the lack of end-to-end understanding by acquisition staff. A simple solution would be to group guidance together, either physically (in soft storage terms) or at least group it logically through a 'portal' page.

There is no sense in grouping all appropriate guidance together if navigation through it is hard. With CDP's [ss] interest in this subject, it would not be unreasonable to modify the acquisition doughnut (something everyone in acquisition can relate to) to include this end-to-end tender process which is the basis of all acquisition work undertaken.

Lessons learned continue to be important and these should be distributed widely to assist the development of appropriate acquisition strategies to maintain the drive for 'faster, cheaper, better.'

Two areas that warrant further investigations are the down-selection trend (or possible lack of) and the concept of risk as value. The down-selection trend could have clear possibilities in speeding up the acquisition process but in the small sample of IPTs interviewed no one undertook such a down selection; however other IPTs may be following this trend. As far as risk is concerned this would be an extension of the existing knowledge provided to acquisition staff to ensure that in the event that risk becomes a contributing factor in a value assessment it can effectively be marked.

6.5 Comments on the MSc Defence Systems Engineering dissertation

This dissertation was specifically produced to cover a number of areas very relevant to this research. It looks at how IPTs view value in the non-monetary sense. It also examines how they assess and mark tenders, and how source-selection decisions are made. It is interesting to note that at the stage when this research was undertaken, the fifth edition of the Acquisition Handbook had been available for just over six months, yet there is no indication of 'effective integration' being of equal importance to performance, cost and time. Furthermore, risk and the whole range of 'other factors' get a low rating by the vast majority of those working in IPTs.

Operational effectiveness, timely delivery and reduced through-life cost are the most highly rated factors and these tie up exactly with Smart Acquisition's faster, cheaper, better. Minimised risk obtained a surprisingly low rating. Neither increased availability nor increased technical capability was considered important, while minimised support and other factors had very low ratings. This gives a clear view of the attitude of some IPTs to value. They require operational effectiveness combined with a timely delivery. While the overarching importance of these two factors is recognised, it is surprising that the risk of not getting what is required when it is required is not considered as important. Risk is not even seen as a value factor!

[ss] Sir Peter Spencer KCB ADC.

7 THE MEASUREMENT OF 'VALUE FOR MONEY' IN MOD

It is important to understand how MoD procedures for selecting new equipment have developed over time and concentrate on understanding MoD procedures presently used to measure 'value for money'. These are discussed and areas where improvements need to be made are identified, together with suggestions for enhancements. Section 2.1.1 posed ten questions, which are answered in this section.

7.1 How does MoD measure and secure value for money?

It is vital to understand the current MoD acquisition procedure and to comprehend how it is implementing government policy to obtain best value for money in its purchases. To establish an initial baseline of how MoD was carrying out procurement in the 1980s, two sources were employed. The first, Professor K Hambleton, in that period held several one and two star posts in MoD (Procurement Executive). The second source is Dr DG Keily's book *Defence Procurement, the Equipment Buying Process,* discussed in Section 4.19. Dr Keily devised and introduced the Cardinal Points procurement procedure for the Royal Navy. These two sources form a baseline that will be brought up-to-date using information from the MoD Acquisition Management System.

7.1.1 Post-war history [tt]

In the immediate post-war period, the expertise for equipment design resided in the government research establishments. These establishments generally issued specifications to industry that responded and contracted on a cost-plus basis.

Mr P Levene, later Lord Levene, joined MoD in the early nineteen eighties and introduced the idea of competition. Industry was recognised as knowing more about its products and undertook the system design, while MoD still understood the design needs. Around the same time, the RN came up with the idea of Cardinal Points Specifications (CPS) but only applied it to off-the-shelf (OTS) products, accepting that CPS could not be compulsory. However, the CPS idea was then applied to new developments and made mandatory. This left many problems including detailed ones such as 'What colour?' The aim was to find the best-balanced product and procure the cheapest compliant solution. CPS was based on capability but looked for existing solutions.

In the competitive era, the stages of adjudication were:

1. Issue a set of mandatory requirements.
2. Get compliance ticks all boxes.
3. Pick the cheapest solution.
4. No assessment of whether the company could make what was required.
5. Problem of grey areas in the specification.

Thus weighted scale evaluation was developed.

[tt] This history is largely the result of discussions with Professor K Hambleton, former Director General Air 3 and Director General Air Weapons & Electronic Systems in MoD PE.

1. All stakeholders agree a list to be scored.
2. Each item is given a relevant weighting.
3. Cost was excluded and left to the contracts department.

In the late eighties, attempts were made to assess cost effectiveness. The scoring curve cut-off might, on occasions, exceed the requirement. Risk and credibility were not built into the scoring system, but were treated as separate items.

7.1.2 The 'Downey' cycle [170]

The Downey procurement cycle, now superseded by CADMID, had seven phases; Concept, Feasibility, Project Definition, Full Scale Development, Production, In-service, and Disposal. It aimed to control risk by a series of project stages with formal decision points between them. During the Cold War there was pressure for projects to be pushed forward into full development and production quickly to meet specific Soviet threats, even though much risk remained: some ran into technical problems which caused delay. Equipment projects were formally approved at each stage in the Cycle.

1 Concept

The first phase of the seven Downey phases involved producing a Staff Target expressing the functions and desired performance of a new system or equipment.

2 Feasibility Study

A study then undertaken in broad terms of technology, cost and time to:

- Assess the feasibility of meeting the Staff Target. (A statement broadly expressing the functions and desired performance of a new equipment and likely problems, objectives and constraints, before the feasibility of meeting the requirement was assessed.)
- Identify alternative solutions, their relative advantages and disadvantages, and key problem areas for further study.
- Provide detailed costed proposals for project-definition studies and information in the detail necessary to draft a Staff Requirement. (A detailed statement prepared after a Feasibility Study describing the function, performance and required in-service date of a proposed new equipment and the environment in which it is to operate.)

3 Project Definition

Project definition involved an investigation, normally undertaken by industry, of sufficient depth to:

- Explore the areas of technical uncertainty involved in meeting a Staff Requirement.
- Evolve detailed estimates of development cost in the form of a development-cost plan with a breakdown of the programme into work packages and (as far as possible) work activities.
- Produce an estimate of total and unit production costs and timescale, and proposals for firm, fixed or incentive price contracts.

For most large and complex projects, project definition would go through two stages:

PD-1. Initial design and experimental work to explore the areas of technical uncertainty and define the technical content of the project, leading to a first development-cost plan.
PD-2. More detailed design and experimental work, including any construction and testing of models and prototypes considered necessary, leading to the production of the information required (as set out above) before a development decision was made.

4 Full Scale Development

A programme was then agreed of detailed design engineering, including the production of models or equipment prototypes where feasible and any necessary trials, leading to the acceptance of the equipment into service; the production of full manufacturing and support information and documentation, and the provision of draft handbooks.

5 Production

Production was concerned with the manufacture of the equipment or system to be used in service and could be split into several tranches. The first tranche might be approved at the same time as Full Development with subsequent tranches approved at later dates. Prior to production of second and subsequent tranches approval was again sought for major projects.

6 In service

The penultimate phase dealt with the provision of in-service support to equipment once deployed included upgrades, improvements and refits.

7 Disposal

The final Downey phase was the disposal of the equipment at the end of its service life.

8 Equipment Approval Committee (EAC)

The MoD EAC was the formal committee for approving equipment procurement programmes. Chaired by the CSA, it was responsible for advising ministers on major procurement decisions and itself authorised procurement within limits delegated ministers.

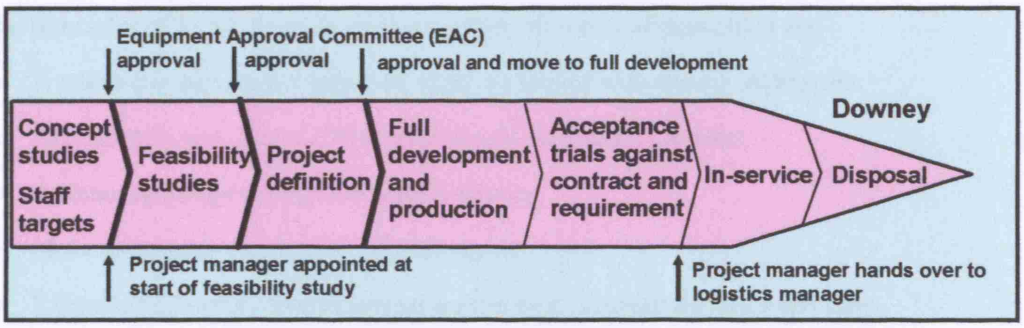

Figure 61 The stages of the Downey procurement cycle.

The various changes in the MoD procurement approach, in the fifty years that followed the end of World War II, are summarised in the following table.

Changes in MoD procurement practice over the last half century		
Time	Specification	Cost plus
	Specification	Cost plus with fixed-size profit
	CPS	Competitive – OTS minimum development
	CPS	Competitive
	Specification	Competitive

7.2 Smart Acquisition [171]

In the late 1990s, Smart Acquisition (initially known as Smart Procurement) was introduced in MoD. It dealt with, among other things with Capability – An operational outcome or effect that users of assets or services need to achieve, and value for money.

The aim of Smart Acquisition is to acquire defence capability *'faster, cheaper, better and more effectively integrated'*. *'More effectively integrated'* was only added to *'faster, cheaper, better'* in January 2004 and the point is made that a solution, which is *'faster, cheaper, better but not effectively integrated'* compromises defence capability.

MoD has made clear to Parliament its determination to ensure that Smart Acquisition delivers projects to performance, cost and time requirements. Compliance with the approvals procedures is a means of limiting technical and financial risk. Other principles include:

- Accurate estimating of WLC from the earliest stages, taking account of past experience, will be given high priority.
- Trade-offs between cost, levels of performance and ISD will routinely be considered.
- A full investment appraisal will be carried out whenever a substantial (over £100,000) investment is contemplated.
- Competition and industrial partnering will be used wherever practicable and appropriate.

The principles of Smart Acquisition that apply to all forms of acquisition are:

- A whole-life approach, typified by applying through-life costing techniques.
- Integrated Project Teams (IPTs) with clearly identified customers.
- A better, more-open relationship with industry.
- More investment during early project phases.
- Effective trade-offs between system performance, through-life costs and time.
- New procurement approaches, including incremental acquisition.
- A streamlined process for project approvals.

Acquisition is based on the CADMID cycle. This involves six stages: Concept, Assessment, Demonstration, Manufacture, In-service and Disposal. The cycle may be tailored for some projects but this is unlikely for major equipment projects. An IPT is formed early in the Concept Phase, and this team is responsible for assessing competitive bids during source selection. The cycle has two approval points: Initial Gate at the end of the Concept Phase and Main Gate at the end of the Assessment Phase. Figure 62 compares the Downey cycle with the CADMID acquisition cycle and shows how the approval stages and the IPT fit into the CADMID cycle.

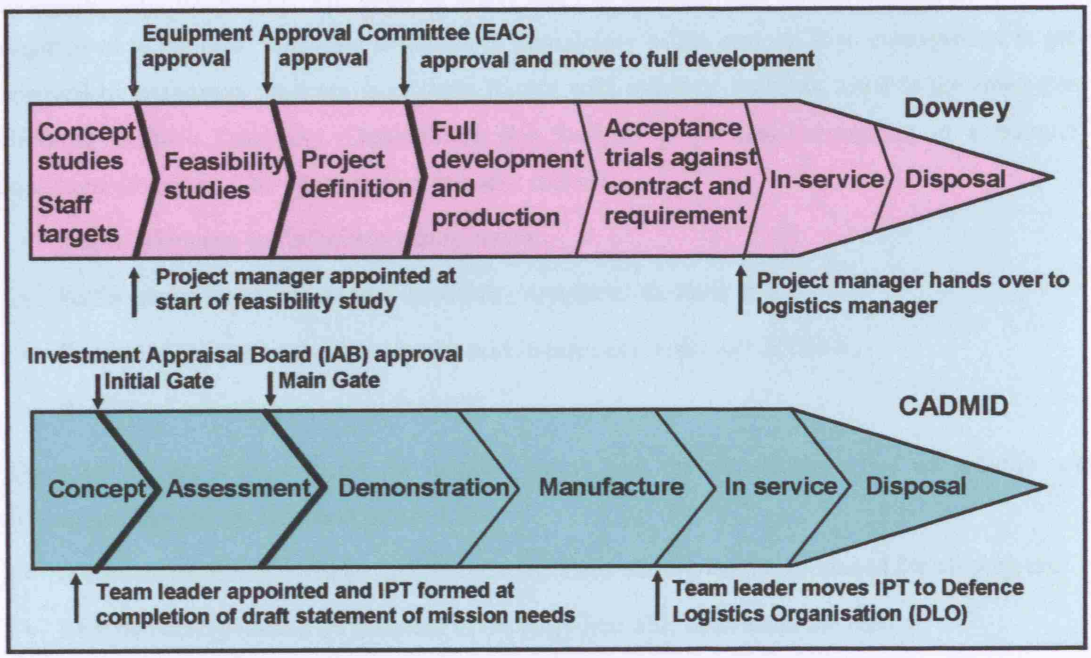

Figure 62 Comparing the Downey procurement cycle with the current CADMID acquisition cycle.

The key tenets of Smart Acquisition are:

- Procuring capability rather than solutions that meet detailed specifications.
- Taking an integrated approach to through-life management and whole-life costs.
- A streamlined procedure for approving projects.
- The use of IPTs.

A key feature of the Smart Approvals process is that almost all projects are required to submit cost and schedule information, with associated confidence figures, derived through quantitative analysis; a process often referred to as 'Three-point estimating'. A task of the IPT and its leader is to manage risk and uncertainty, and exploit opportunities with the clear aim of achieving on average the 50% confidence figures declared at Main Gate approval.

- Approvals will set a limit, which is the highest cost and latest time acceptable without re-submission for approval.

- The 10%, 50% and 90% confidence figures for both cost and time are noted.
- The 50% confidence figures are usually used to determine affordability, set funding and drive the planning assumptions for the non-equipment Lines of Development.[uu]

7.2.1 Risk

Risk management allows an informed judgement to be made on the degree of risk in project proposals. It confirms that the balance struck between performance, whole-life cost, timescale, and risk represents value for money. The level of effort and resources applied to risk management should be proportional to the cost, timescale and level of complexity of the project. Risk management is greatly improved by managing progress in projects jointly with industry, working towards the same goal of delivering defence capability. Quantitative risk analysis helps decision-making in a number of acquisition processes. The ones relevant to value include:

- Project planning and schedule management.
- Performance management (e.g. capability/requirements trade-off).
- Combined Operational Effectiveness and Investment Appraisal (COEIA).
- Business Case submissions to the IAB.

Quantitative risk analysis must be iterative throughout the acquisition cycle to provide robust information. Key points for managing risk are:

- A risk-management strategy and risk-management plan should be produced for all projects.
- Risk ownership should be assigned to the party best able to manage the risk.
- Acceptable levels of risk should be agreed at all major decision points.
- IPTs and their contractors should, when appropriate, operate a common risk-management process that utilises common risk information.
- Contractor risk-management requirements should be included in ITTs and subsequent contracts.
- Risks should be described using defined terminology understood both by MoD and contractors.

Investment in de-risking technology in the early stages of the Acquisition Phase, prior to Main Gate approval, is a key feature of Smart Acquisition. This may involve trading current capability for investment in risk reduction in new capability, or de-scoping planned new capability to that for which adequate risk reduction can be funded.

7.2.2 Tender assessment [172]

On receipt of responses to an ITT, tender assessment is undertaken by the acquisition team to determine which compliant tender offers the best overall value for money in meeting the requirement.

[uu] The six lines of development are: Concepts and doctrine, Personnel, Equipment and technology, Structures and estates, Sustainability and Training.

Any tenders delivered after the due date and time or any amendments to tenders received during the assessment will not normally be considered and must be referred to commercial staff for advice. Any clarification of tenders must also be referred through commercial staff.

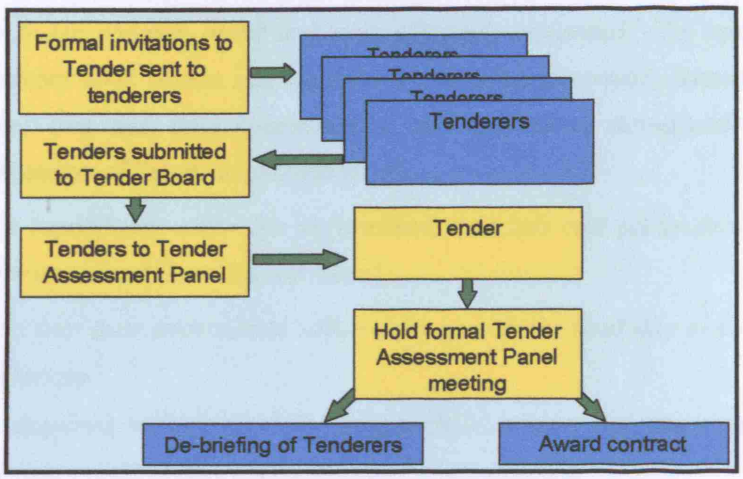

Figure 63 The basic stages involved in the MoD tendering process.[173]

Tender assessment is a team activity although the commercial and technical analyses are normally undertaken independently. Tender evaluation must be objective and carried out in accordance with the marking and compliance scheme set out in the ITT because of the potential risk of misfeasance.

Figure 64 is a model specially developed to help understand the MoD selection process. It shows the wide range of issues that must be handled by IPTs and the IAB to arrive at optimum acquisition decisions.

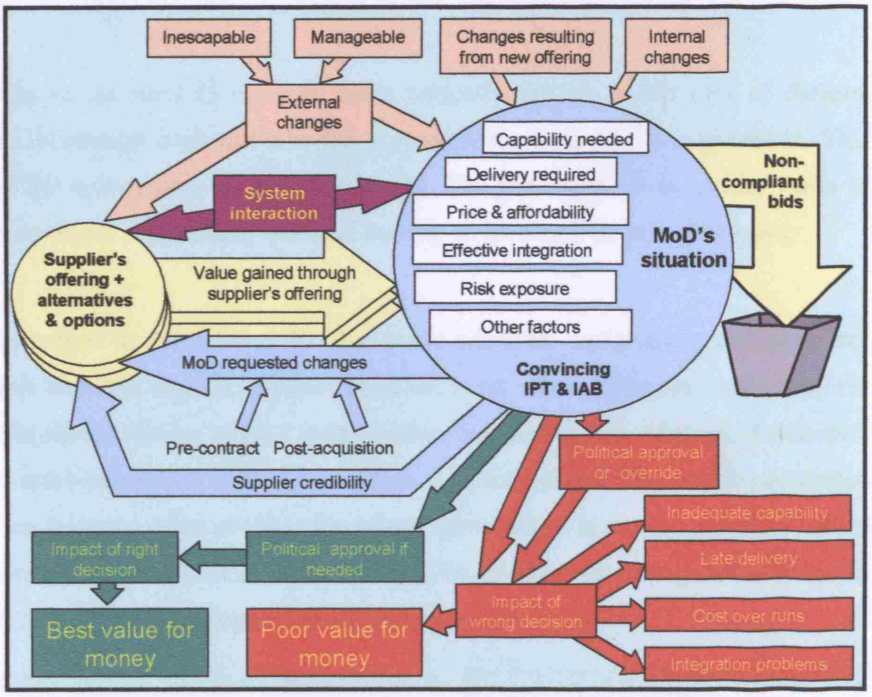

Figure 64 A model of MoD contractor selection following submission of tenders.

7.2.3 The Smart Acquisition Handbook[174]

The Smart Acquisition Handbook – A Guide to Smart Procurement 'Faster, Cheaper, Better', which forms part of the Acquisition Management System, explains how Smart Acquisition came about, sets out its aims and objectives, describes the new business processes and organisational structures that support it and explains where to find out more about Smart Acquisition. The aim of Smart Acquisition

is: '*To acquire Defence capability faster, cheaper, better and more effectively integrated.*' The last point is new since the previous January 2002 edition and the point is made that integration carries equivalent weight to performance, cost and time considerations and emphasises through-life effectiveness and efficiency. The objectives of Smart Acquisition are to:

- '*Deliver and sustain defence capabilities within the performance, time and cost parameters approved at the time the major investment decisions are taken.*'
- '*Integrate defence capabilities into their environment within defence, with the flexibility to be adapted as the environment changes.*'
- '*Base future procurement on acquiring military capability progressively, at lower risk, and with optimisation of trade-offs between military effectiveness, time and whole-life cost.*'
- '*Cut the time for key new technologies to be introduced into the frontline, where needed to secure military advantage and industrial competitiveness.*'

Smart Acquisition provides a better way for MoD to decide '*what equipment capability is needed ... how that capability should be specified, procured, supported ... maintained and improved, and safely disposed of ...*'

One of the key themes is the need to examine more critically the whole-life cost of defence equipment to ensure that investment decisions take full account of the longer-term implications. This is important in terms of the money part of value for money. The remainder of the guide, while of import to those working on Smart Acquisition, has little bearing on gaining best value for money.

7.2.4 Comment

No guidance is given on how to measure value. If faster is not achieved, equipment could be so late into service that it cannot meet the requirement and has little or no value. 'Cheaper' deals with the financial side of value for money. Better implies greater value, but therein lies a danger. Better than what is required may be more expensive, may take longer to enter service and may provide unneeded capability. It thus may not improve value or value for money. However, it also may provide a battle-winning capability requiring a review of the needed capability. More effectively integrated is essential for a networked-enabled capability and for operating with allies.

Figure 65 shows the key drivers of Smart Acquisition. It implies that value comes solely from solutions with better performance, delivered faster and more effectively integrated. While these are vital parameters, 'with minimum risk' could be considered equally important. Other factors, while clearly less vital, may still impact on what is best value for money.

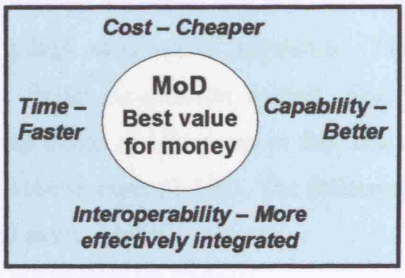

Figure 65 MoD requires equipment to be 'Faster, cheaper, better and more effectively integrated.'

7.3 Acquisition Management System [175]

7.3.1 Overview

UK MoD's Acquisition Management System (AMS) is a pan-MoD acquisition information tool using web-based technology. At its heart lies the ellipse graphic, reproduced as Figure 66. The upper half of the ellipse shows the six stages of the CADMID cycle and provides access to a series of broad-brush overviews of the activities within each project stage. At the appropriate places in the project cycle are two 'Gate Symbols.' The lower half of the ellipse is dedicated to roles and responsibilities; acquisition organisations, principles and people. At the centre lies the Acquisition Handbook described above.

The AMS is the 'bible' for obtaining major new items of operational equipment. Unlike the bible, the AMS is rightly and constantly varying to match enhancements in acquisition policy. It is an enormous collection of documents taking up approaching 1 GB of disk space and is available on-line, though a few classified documents [vv] are only accessible through MoD terminals.

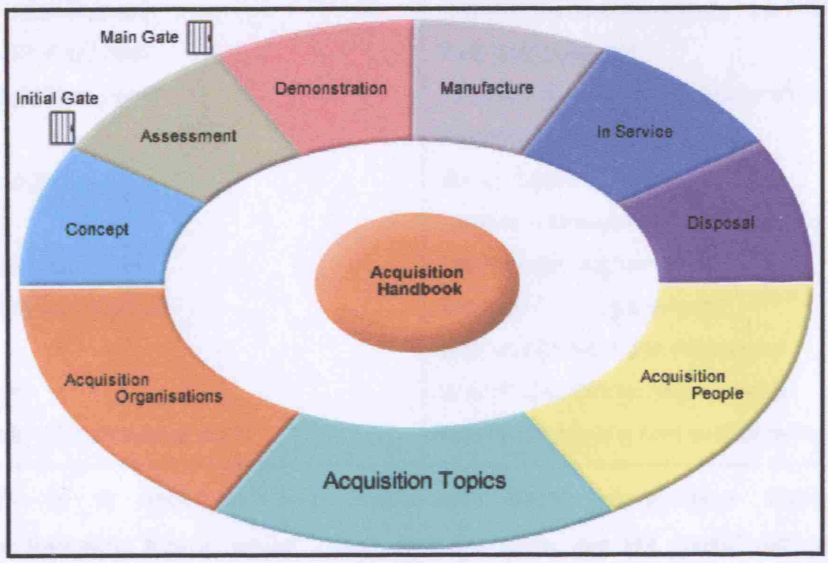

Figure 66 The AMS graphic that details the main parts of the system.

In July 2000, the Chief of Defence Procurement Instructions were replaced by instructions and guidance made available through the AMS.[ww] At the same time the AMS was recommended as DPA's first choice for acquisition guidance and instructions, and that it should continuously be developed.[176] One of the difficulties for this research has been that the AMS is a living document that is continually changing. These changes are essential to the maintenance of a high standard of acquisition. The incorporation of a fourth factor, '*effective integration*', to the Smart Acquisition epithet '*faster, cheaper, better*' required significant late changes to a number of the words and diagrams in this thesis. Thus, this research is based on the content of the AMS as it was in the summer of 2005. The following is a list of the main topics relevant to this research that are covered in the AMS:[177]

[vv] Classified documents are excluded from this research.
[ww] With effect from 1st August 2000.

3-point estimating	Obsolescence management
Acceptance	Off-the-shelf procurement
Acquisition Competence framework	Commercial and contract management
Maturity models	Customer/Supplier Agreements
Organisations (MoD and external)	Defence Industrial Considerations
Policy and process ownership	Policy
Stakeholders	DLO
Approvals/Business Cases	DPA
Capability working groups	ECC/capability management
COIEA	Overseas procurement
Government furnished assets	Partnering
Hybrid projects	Procurement, support and contract strategy
Incremental Acquisition	PPP/PFI
Involvement	Requirements engineering incl. URDs and SRDs
Participation	Risk management
Integrated logistic support	SCRIA – Supply chain relationships in action
IPTs	Second Customer
Integration authority	Smart Acquisition
IPR	Targets – baseline, hard and stretch
International co-operation	Technology readiness levels
Interoperability assurance	Through-life management
Legislation	Upgrading in-service equipment
MoD agencies	Urgent operational requirements
National Audit Office/internal audit	Whole-life costing and cost of ownership

The AMS is a tool to help implement Smart Acquisition throughout MoD. However, the following topics, whilst given extensive cover, are not considered pertinent to this research. They include information about research, equipment design, certification, safety, operation, support and logistics, many commercial, financial and staff issues, project management, systems engineering and design, including standards and standardisation, and finally security. In terms of MoD's acquisition policy of obtaining best value for money in its source selection procedures for the acquisition of major operational equipment, the starting point is the concept phase of the CADMID cycle.

7.3.2 Concept Phase

The first phase of any project involves arriving at a suitable concept. During this phase the embryonic IPT, with members from industry as appropriate, is formed while a Capability Working Group will, with the assistance of the IPT, produce the basic User Requirements Document (URD). This document defines the current user need and identifies and costs technological options and procurement strategies

that warrant further investigation. A Business Case must be assembled for Initial Gate approval at the end of this phase.

7.3.3 Assessment Phase

The importance of the Assessment Phase from the point of view of this research is that at the end of this phase source selection may be made for major operational equipment purchases. During the Assessment Phase the IPT:

- Produces a baseline Systems Requirement Document (SRD).
- In conjunction with the Equipment Capability Customer (ECC) agrees a Customer/Supplier Agreement that specifies all project deliverables to meet the equipment ISD.
- May let competitive feasibility studies to industry and evaluate performance/cost trade-offs/whole-life cycle costs, risks and risk reduction plans, and the ISD.
- Produces the final Business Case, justifying full project funding.
- Passes Main Gate, approving time/cost/performance for equipment supply and budgets for Through-life Support (TLS).

When an ITT is issued industry membership of the IPT will be suspended. The process for working with industry Concept-Phase participants who have made a contribution at that stage will clearly be established. Dialogue may continue, however responses to technical question are to be provided only to the company that asks. Answers to questions on process must be supplied to all contenders. When operating competing approaches, protection of information is paramount. The availability of increased funding for this stage (**Comment**: This is clearly not happening – see Section 4.7) will enable multiple, competing designs to be developed. Once a contract is in place all parties have common goals for which an effective partnering approach can be optimised.

7.3.4 Demonstration Phase

In this phase, industry involvement expands, with more people from the competing teams or from the prime contractor. There is the potential for the IPT to be co-located at the industry site. With multiple industry involvement the IPT will not necessarily be able to resource several industry sites, so only some ITP members may be co-located.

Appropriate working procedures are required to protect sensitive information, and at the end of this phase a decision will be made to appoint a contractor, with time, performance and cost targets established and committed.

The IPT may let competitive preliminary design contracts to industry to reduce development risk, to produce risk-reduction plans and to evaluate further performance/cost trade-offs. (**Comment:** Why are timescale and effective integration trade-offs not included here as well?) The IPT will also try and firm

up life cycle costs and the ISD. Finally it should evaluate potential gainshare and incentivisation opportunities. The IPT will assess competitive solutions and let one or more contracts to industry. Industry members are fully integrated into IPT and the Customer/Supplier Agreement revised to reflect all project deliverables to achieve ISD. Completion of the Development Phase culminates in acceptance of equipment performance by the Central Customer for production release.

7.3.5 Manufacture Phase

Contracts have been awarded; focus is on executing the contract and project managing the resources to deliver the commitment. From the point of view of this research, from here the main source-selection judgements are concerned with through-life support, though further technical risks are identified right up to confirmation of the final specification. This may include complex systems-integration tasks. The IPT interacts with the systems designers to investigate trade-offs based on incremental acquisition and/or technology insertion. Cost reduction and improvement programmes may be undertaken as well as effectiveness, reliability and availability trials to prove in-service sustainability. At the end of the Manufacture Phase, line management of the IPT transfers from CDP to CDL.

7.3.6 In-Service Phase

During this phase project responsibility moves from the Central Customer to the Second Customer with the necessary change in IPT scope and membership. Agreed upgrades, improvements, refits or acquisition increments are carried out. Both industry and DLO staff may consider new options for support and innovative proposals that need to be viewed positively. The IPT maintains value for money scrutiny and implements gainsharing plans with industry where beneficial.

7.3.7 Disposal Phase

This final phase involves plans to realise efficient and safe equipment/system disposal.

7.3.8 Smart Approvals

The instructions and guidance on IAB and delegated approvals [178] have been issued by the Investment Approvals Board (IAB), which replaced the Equipment Approvals Committee.[xx] The instructions apply, amongst others, to all equipment projects and PPP projects. The key principles of approval are that the project is:

- Fully justified and coherent with long-term defence investment strategies and plans, and integrated with other MoD initiatives and projects.
- Designed to meet a capability in a way that is appropriately flexible and adaptable to future military tasks.
- A cost-effective means of delivering optimised military capability that offers through-life value for money.

[xx] On 2 April 2002.

- Affordable within existing and foreseeable future budget provision, taking account of the anticipated cost of ownership profile.
- Deliverable through effective acquisition management and commercial arrangements.
- Soundly based, with key risks to performance, cost and timescale identified and actions planned to monitor, manage and mitigate those risks.
- Consistent with MoD's strategic investment plans and affordable when set against other priorities.
- Well-founded in relation to the delivery of customer requirements and offering value for money.
- Comprehensive in taking account of implications across all key cost-drivers. [yy]
- Deliverable through sound project management and Smart Acquisition arrangements.

The purposes of the approvals process, which are relevant to this research, can be summarised as ensuring that investment projects:

- Represent value for money.
- Are affordable and accord with the defence and investment strategies.
- Can be procured and supported cost-effectively on a whole-life cost basis.
- Have properly addressed risks to delivery.

7.3.9 Investment Approvals Board (IAB) [179]

The IAB is responsible for the advice that is given to ministers on the projects that it considers. Decisions to approve or reject cases for investment in Cat A projects (those above £400M) are taken by ministers. The delegated IAB approving authorities have, similarly, a collective as well as individual accountability. The IAB acting on behalf of the Defence Management Board:

- Makes recommendations to ministers on the procurement of major defence equipment for which their approval is necessary.
- Authorises expenditure on major defence equipment within the financial levels delegated to it by ministers.
- Keeps under review procedures for the formulation and scrutiny of requirements, and for the approval of defence equipment and works projects.

The following are members of the IAB: Chief Scientific Adviser (CSA) – Chairman, Vice Chief of the Defence Staff (VCDS), 2nd Permanent Under Secretary (2nd PUS), Chief of Defence Procurement (CDP) and Chief of Defence Logistics (CDL).

DECs and IPTLs (and other project sponsors) are jointly accountable for the content of Business Cases (BCs), including the accuracy of financial information. Nominated scrutineers, representing the

[yy] Such as equipment, manpower, infrastructure and training.

interests of 2nd PUS and CSA, are responsible for reviewing the BC and advising any changes needed to reflect their views. If the advice cannot be incorporated, they may prepare an independent review for submission with the BC.

Technical staff, together with DPA or DLO finance scrutineers, will work closely with Capability Working Groups and IPTs in preparing BCs. Issues they will consider include:

- Is there a fully justified equipment capability need; would the investment proposed to meet it represent value for money; and can the expenditure therefore be defended to Parliament by ministers and the Accounting Officer?
- Have all the implications of defence policy and doctrine, resource availability, and industrial and collaboration policies been taken into account?
- Has the best means been identified of achieving a cost-effective whole-life solution? At the Main Gate, has the recommendation on options taken into account the findings of the COEIA, have the through-life cost, time and performance trade-offs been done optimally, and has sufficient risk been removed to give confidence in much narrower parameters?

The division of 2nd PUS's and VCDS's delegation (Figure 67) shows that both refer to DG RP for financial scrutiny of projects, but the scrutiny is carried out by both DG Information and DEC(CCII). In order to retain the framework of five approving authorities for any project either CM(IS) or DG Info will provide approval covering capability management issues, always consulting closely.

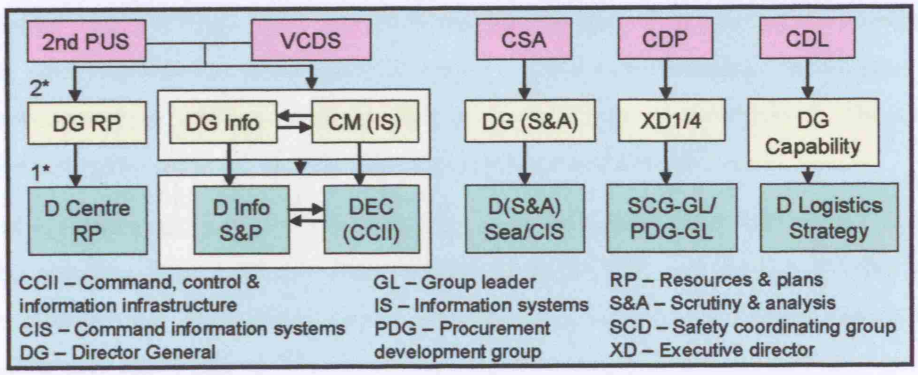

Figure 67 Those in MoD involved in scrutiny and approval of equipment projects.

MoD holds quarterly meeting with Treasury, DTI, FCO and Cabinet Office to consider the future approvals programme. The Treasury decides at these meetings the projects (normally major projects only) on which it wishes to be consulted. Treasury must also be consulted on all PPP/PFI projects where the capital value of the Public Sector Comparator is £50m. Treasury approval is required for:

- All Cat A projects and certain lower-value equipment projects.
- Business information systems and telecommunication projects with a whole-life cost value of £100m or greater.

Project approvals at the Main Gate will be based on the BC submitted jointly by the DEC and IPTL.

7.3.10 Approval guiding principles[180]

MoD has made clear to the Public Accounts Committee that it is determined to ensure that Smart Acquisition delivers projects to performance, cost and time requirements. Compliance with approvals procedures is a means of limiting technical, financial and commercial risk. Other principles include:

- Robust estimating of the cost of ownership (COO) from the earliest stages, taking account of past experience, will be given high priority.
- Trade-offs between cost, levels of performance and in-service date[zz] will be routinely considered (within the PCT envelope).
- The scope for competitive procurement and for industrial partnering will be explored routinely, and used wherever practicable and appropriate.

Nominated scrutineers are responsible for reviewing the BC and advising any changes needed to take account of their views. If their advice cannot be incorporated, they may prepare an independent review for submission with the case.

*1 **IAB scrutiny and approvals processes and delegated approving authorities*** [181]

Under the heading '*Processes and working practices*' this document states:

> *'The approvals process involves consideration ... of a Business Case for the investment ... The case recommends investment, via a specified route, to meet a planned (and funded) requirement, or an assessment of potential solutions, within defined performance, cost and time parameters – the 'PCT envelope'. The PCT 'envelope' is thus at the heart of the approval. It is crucial, since it is either a breach of the 'envelope' ... or a major change in the requirement, or the procurement or support strategy, that requires a (timely) re-approval. The IAB and Ministers therefore set great store by the three-point cost and time estimates.'*

The need to identify and manage COO is recognised at the highest levels in the MoD. Consequently all projects reaching Main Gate and being submitted to the IAB will include a COO analysis to determine affordability. This will provide a complimentary view to the existing requirement for a cash-based Investment Appraisal. [182]

Comment: Soft issues, contract terms and industrial issues are not mentioned. It is only Annex A of this document that asks whether wider factors, including industrial, environmental and legal issues have been properly assessed and taken into account. The same Annex raises the questions of adequate risk-management arrangements and whether the investment represents value for money through life.

[zz] This concentration still excludes 'effective integration' although Interoperability Key Requirements and Interoperability User Requirements are mentioned.

2 *Approvals for new and existing projects*

All projects should follow the Smart Approvals[183] cycle, but many will have received endorsement under the previous regime (the 'Downey' cycle). The BC is the rationale for proceeding with investment in a project and therefore to justify equipment projects it needs:

- The likely operational environment (having noted the predicted threat), alternative ways of meeting the requirement and current investment in equipment offering a similar capability.
- The capability sought, in terms of the desired performance, ISD and future use and development of the equipment, together with an intelligence assessment of its potential vulnerabilities to current and future threat systems.
- How, given the options available and the scope for trade-offs, the requirement could be procured cost-effectively and afforded through life.
- The procurement and support strategies, including any industrial implications.

3 *Approval levels*

The level of consideration of individual equipment projects by 'approving authorities' is mainly determined by their total (UK) expected acquisition cost expressed in cash terms at constant prices. The total cost of ownership, the risks associated with a project, any novel or contentious features, or significant policy issues will also be taken into account.

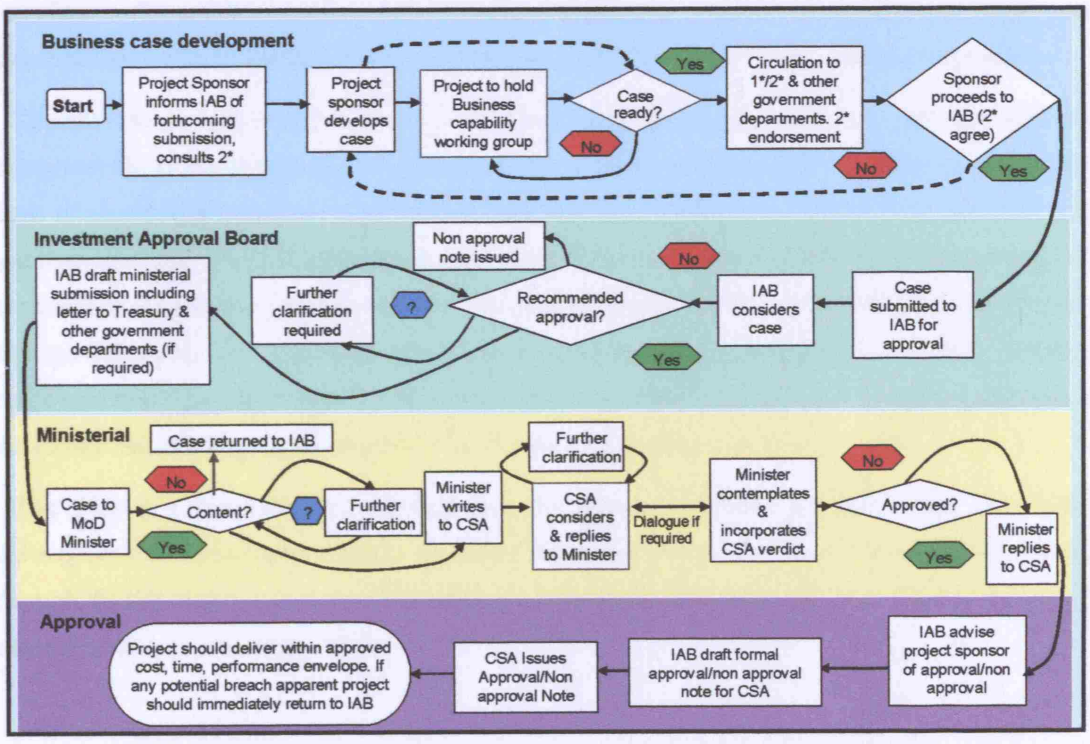

Figure 68 An abridged version of the IAB approval procedure for Cat A projects.

Quarterly meetings are held with HMT, DTI, FCO and Cabinet Office officials to consider future approvals programme. The Treasury decides at these meetings the projects (normally major projects

only) on which it wishes to be consulted at Chief Secretary or official level. The current (end 2005) approving authority levels are shown in the following table.[184]

Category	Procurement cost	Approving authority level
A	Above £400M	IAB (CSA, 2nd PUS, VCDS, CDP & CDL) then ministers
B	£100M - £400M	2*/ML2[aaa] – DGE, DG(S&A), relevant CM, DPA XD & DG ES
C	£20M - £100M	1*/ML3 – DCRS, D(S&A), IPTL, relevant DEC & D Tech
D	Under £20M	1*/ML3 or below – IPTL & DEC representative, finance officer

4 Comment

These instructions and guidance provide a clear view of the factors to be considered by the IAB before Main Gate approval is given to any major operational equipment procurement. It is rather as an afterthought that the need to take into account wider factors and adequate risk management arrangements are mentioned. The need to ensure that the investment represents value for money through life begs the question of how this can be ensured, given the extremely long equipment lives.

7.3.11 Smart Requirements Model [185]

As a part of the Smart Acquisition Initiative, MoD is adopting Smart Requirements to capture, engineer and manage requirements based on system engineering principles. The key objectives are to introduce a through-life, evolutionary requirements process, which will integrate all requirements stakeholders and facilitate delivering, and sustaining, affordable and effective defence systems.

The old Downey procurement process tended to be solution focused, with early attention paid to the characteristics of the equipment to be procured. The majority of procurements proceeded purely on the basis of an assumed solution, resulting in a concentration on equipment performance rather than user and system needs. Smart Requirements moves that focus to the needs of the users by defining '*what the users of a particular future system will need*' and focuses on the requirements for whole systems through-life, rather than just initial procurement. A complete and consistent requirement is defined, but is split into User and System Requirements Documents (URD and SRD)[bbb] reflecting user needs in the former and refining requirements on the system to fulfil those needs in the latter.

The URD is a compilation of requirements, descriptions, concepts and definitions. They will be drawn from the requirements database and other supporting documents. It will be updated as necessary through the life of the system to reflect changing user needs, but will also be baselined as necessary to allow project approval to take place.

[aaa] ML2/ML3 – Civil service grades, DGE – Director General Equipment, CM – Capability Manager, ES – Equipment support, DCRS – Director Capability Requirements Scrutiny. For other abbreviations see Figure 67.

[bbb] The URD consists of a complete, structured set of user requirements supported by other documents. Although periodically baselined, the URD is continually evolving. The SRD captures all relevant system requirements and may take the form of a paper document or a computer database underpinned by a management tool.

The SRD forms the baseline of any development and production contract and, should always aim to express its requirements in contractable terms. To allow the full consideration of all possible solutions, the SRD must avoid statements that define how the system should be designed.

By Main Gate, the requirement is fully populated and verified, and able to form the basis for contracting for full system development and production. By this stage the requirement must include measurable and achievable acceptance criteria against all contracted system requirements. The complete requirement should form part of the ITT.

1 Smart Requirements Model - Key Requirements [186]

Key Requirements (KR) are defined as those individual requirements which are assessed as key to the achievement of the mission need, or which are for some other reason assessed as of particular interest to management. Smart Requirements maintain a distinction between user and system requirements during the evolution of a requirement. Hence KRs exist as either Key User Requirements (KURs) or Key System Requirements (KSRs). KURs are those individual requirements with the minimum level of performance envelopes and are used to characterise of the most critical aspects of URD within a Business Case. KSRs are those System Requirements that may be assessed as of particular interest to management.

Every user requirement should include six individually identified features:

1. The Requirement Descriptor is that part of the User Requirement that describes in qualitative terms the nature of the capability required. The descriptor should capture capability needs rather than system requirements.
2. For each Requirement Descriptor, the effectiveness envelope specifies a range within which the system performance parameters must deliver capability. Effectiveness may need to capture confidence levels and environment in specifying the standard needed. Where a requirement is deemed key, the KURs for approvals and measuring performance refer to the minimum acceptable performance level. The envelope normally includes expected effectiveness and may include an upper bound beyond which no resources should be expended investigating solutions.
3. All User Requirements should (and KURs must) be 'measurable'. The verification criteria set out the mechanism to be used for acceptance. The standards the system is required reach, to satisfy the effectiveness envelope, are set out in the acceptance criteria; part of the SRD.
4. The justification for each requirement and the effectiveness specified must be recorded. Audit trails must be provided to justify decisions and inform trade-offs.
5. To guide the IPTL in conducting trade-offs, a priority may be set against various levels within each effectiveness envelope.
6. Remarks should be used to amplify aspects of a requirement and to record trade-offs.

2 Guide to producing User Requirement Documents (URD) [187]

The URD is an all embracing, structured expression of the user needs for a bounded operational capability. The URD states the requirement for a through-life capability. Each URD is a pack of documents. They are a compilation of requirements, descriptions, concepts and definitions. They consist of a complete set of individual user requirements and other supporting documents.

Defining Users

It is important to identify all possible users of a proposed capability and to involve them in the requirements-capture process. Defining users is not simple. It is important not to assume that only the requirements of the Second Customer or those with a particular cap-badge need to be included. Nor will the user necessarily be the operator of the system, who may be considered to be part of the solution. The URD must consider all requirements arising from any source that may influence the required capability. These will arise primarily from the needs of users, but other influences may lead to requirements or constraints that need to be included. Users are:

- Those who benefit from the operation of the capability.
- Those who may interact directly with the capability, including consideration of capabilities that may interact.
- Those responsible for supporting and disposing of the system.

Potential needs arising from wider influences should also be considered:

- Suppliers.
- Enemy.
- Other government departments.
- Public.
- Environment.

Five different priority levels of are included in URDs, which may well form the basis of weightings during bid evaluation. These are: Mandatory, Key User Requirement, Priority 1, Priority 2 and Priority 3 in descending order of importance. It should be noted that requirements define the problem, so if requirements change, they will define a different problem. A constraint is an imposed condition that limits possible solutions or freedom of choice of the supplier of the solution. A constraint is generally non-negotiable, unless it makes it too difficult or impossible to provide an economic solution.

3 The User Requirements Document [188]

Smart Requirements is MoD's application of systems engineering to the capture, articulation, production, management and communication of equipment capability needs. It needs consideration of:

a. Capability need before solutions.

b. All possible solutions with no unjustified assumptions.

c. The system in the context of other co-operating and hostile systems.

d. The users as integral elements of the system.

e. The requirement for the entire system throughout its life.

Smart Requirements are fundamental to a 'whole system, whole-life' approach, and are a key enabler in the achievement of 'faster, cheaper and better acquisition'. A URD comprises a structural diagram of the requirement, a complete set of capability requirements, and any user and organisational constraints.

4 *The System Requirement Documents (SRD)*

The process that will generate a full set of System Requirements is described in the Guide to producing System Requirement Documents.[189] The SRD provides the basis of the specification for any equipment or system contract let either for development or for production of a capability. It must, as far as is possible, leave open to potential suppliers the type of solution that could meet the requirement. The SRD can be considered as the primary product of the System Requirements process. The guide includes three useful diagrams reproduced as Figures 69 - 71.

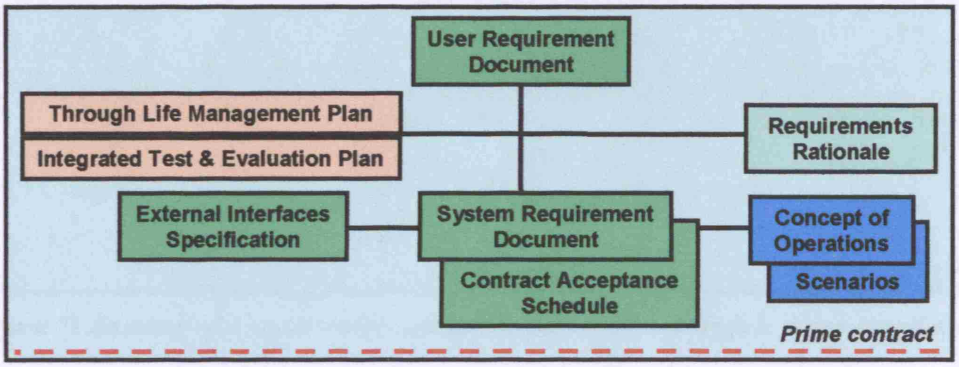

Figure 69 A typical specification tree showing most documents used in Smart Acquisition.

The first diagram (Figure 69) shows the inter-relationship between most of the important documents produced by MoD prior to contracting with industry for any major equipment acquisition. The second replicated in Figure 70 shows how the user and system requirements tie into the CADMID cycle.

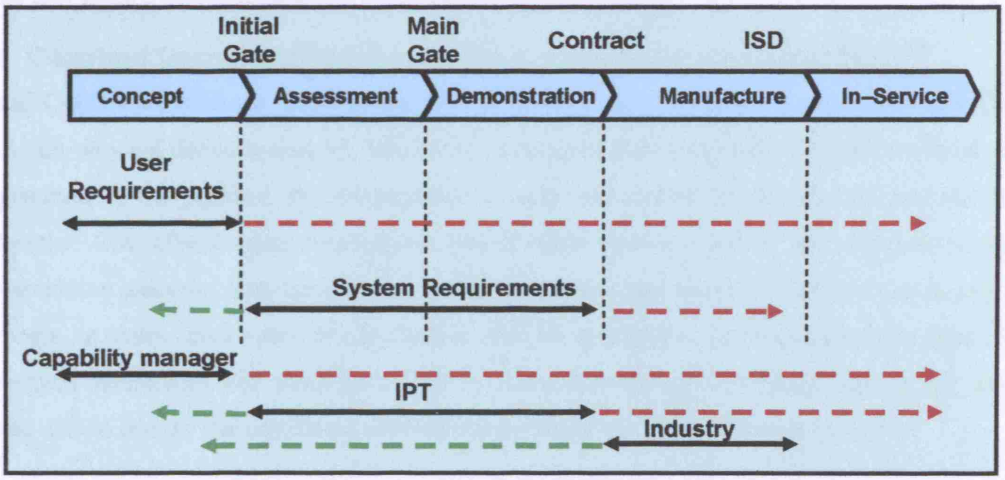

Figure 70 The CADMID cycle showing when industry normally comes under contract for production following the main investment decision-making process.

Figure 71 shows the third diagram indicating how complex the whole documentation process can be. This will obviously be particularly so for the acquisition of major items of operational equipment.

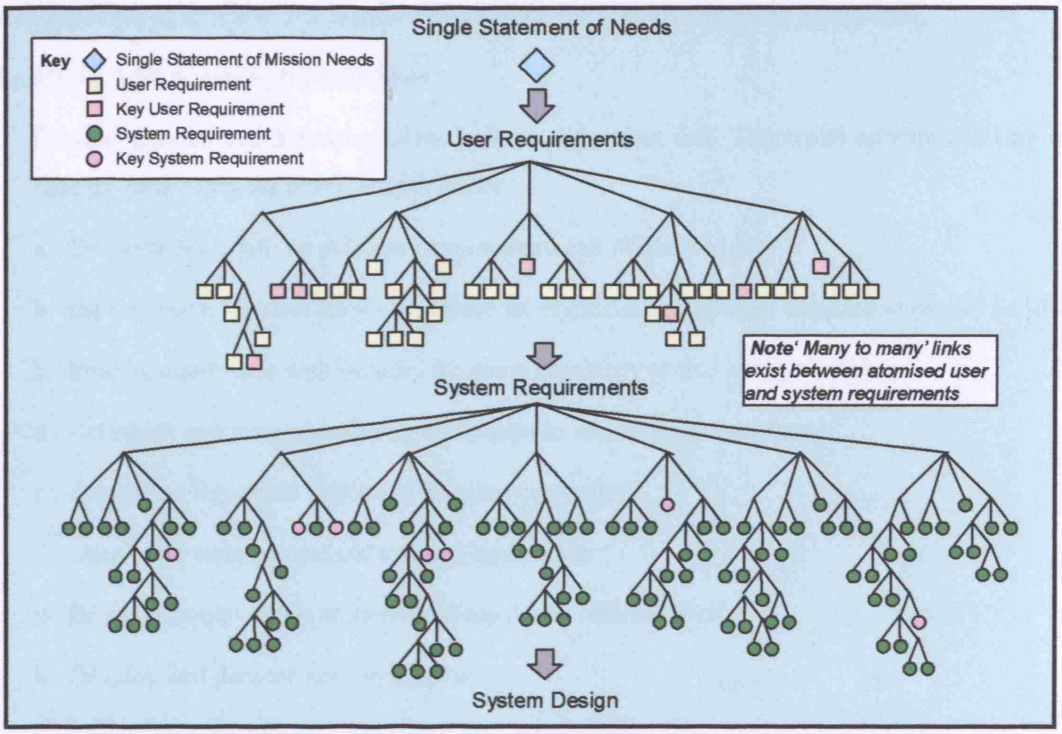

Figure 71 Anatomy of a requirements set; the documentation process is a very complex one.

5 Comment

The five documents covered in Smart Requirements show that the process involves capturing stakeholder information about the capability required and configuring that data so that it can form the basis of a contract with a supplier. This information provides the basis for the COEIA effectiveness analysis that gives a useful measure of the operational part of value.

7.3.12 Combined Operational Effectiveness and Investment Appraisals (COEIAs) [190]

A formal COEIA provides the basis for the main investment decision-making process at Main Gate. A COEIA can only aid decision-making, and needs to be applied pragmatically. Tools employed should be appropriate to the problem, the decision to be made, the availability of data and any underlying uncertainties. Cost-effectiveness assessments and COEIAs should not only use computer modelling and quantitative analysis. Structured decision-aids, judgement and historical analysis can form part of the process. In many cases a mix of quantitative and non-quantitative techniques is appropriate. Cost-effectiveness assessment will assist the IPT/IPTL in down-selecting technology options and carrying out trade-offs to narrow the cost/time/performance envelope during the Assessment Phase.

Before commencing a COEIA, a Concept of Analysis should be prepared describing how the work is to be done. The Concept of Analysis sets out options to be examined, scenarios and concepts of operation to be assumed, proposed data sources and costing assumptions, measures of effectiveness,

analysis techniques and models to be used, and how results will be presented. It sets ground rules and acceptance criteria for the COEIA. At this early stage any limitations of the analytical techniques must be recognised so as to arrive at a credible programme for cost-effectiveness assessment.

The key COEIA activities are as follows:

1. Conduct a structured definition of the options and collect data. The actual options will vary on a case-by-case basis but possible options are:
   a. Do nothing i.e. run on existing equipment to end of planned life.
   b. Do minimum i.e. minimum refurbishment of existing equipment required to extend its life.
   c. Procure equipment with broadly the same capability as that being replaced.
   d. Refurbish and enhance existing equipment to improve its capability.
   e. Procure an improved version of existing equipment.
   f. Loan/lease arrangements of existing equipment.
   g. Buy new equipment with improved capability 'off-the-shelf.'
   h. Develop and procure new equipment.
   i. Private Finance Initiative/Private Public Partnership.
   j. Alternative novel/radical solution?
2. Assess the Operational Effectiveness (OE) and WLC of all options under consideration. The risk associated with any other contributory factors e.g. environmental, industrial or social issues, should be combined with a COEIA assessment.[ccc] In the case of overseas procurements, security of supply, export potential and exchange rate risks should also be included.
3. Conduct a risk assessment of OE and cost to scope the requirement for sensitivity analysis and to allow cost-effectiveness envelope prediction for incremental projects.
4. Compare the options and identify the most cost-effective option in a COEIA paper.

1 Comment

In the first sentence of Section 7.3.12, the words '*the basis for the main investment decision-making process*' have been underlined. The work carried out in compiling the COIEA purposefully does not take account of all the issues necessary to decide which solution offers best value for money. These missing factors, such as the decision's effects on the UK defence industrial base and on any relevant other factors are usually found in the associated Business Case. The apparent weaknesses of the COEIA system are that:

[ccc] In the Business Case.

1. The COIEA, and not the Business Case, is used as a basis for the main investment decision-making process.
2. Is it really feasible to establish whole-life costs, given the extremely long in-service period of major items of military equipment?

7.3.13 Business Cases[191]

A Business Case (BC) is the justification for proceeding with investment in a particular phase of a project and so must set out the planned programme of work that will explore options and reduce risks to manageable levels. It therefore needs to set out:

- The likely operational environment (noting the likely threat), alternative ways of meeting the requirement and current investment in equipment offering a similar capability.
- The capability sought, in terms of the desired output, ISD, future use and development of the equipment.
- An intelligence assessment of its potential vulnerabilities to current and future threats.
- How, given available options and the scope for trade-offs, the requirement could be procured cost-effectively and afforded through life.
- The procurement and support strategies, including any industrial implications.
- A costed plan for delivering the project and managing it through life, with the key milestones and risks identified.

It may help to regard the BC as being composed essentially of two main elements:

- A 'customer focus' on the military customer's requirement (DEC lead).
- A 'supplier focus' on the procurement and support strategies (IPTL lead).

A third element may be critically important – an independent review of the case by technical and finance scrutineers.

Nominated sponsors should be appointed for the main elements of the BC – normally, a DEC and IPTL representative. It is their responsibility to ensure that stakeholder representatives who are not members of the Capability Working Group or IPT are consulted and their interests taken into account in the preparation of the BC. The DEC has lead responsibility for proposing the case and meeting the approvals timetable.

Initial work in the Concept Phase and on the development of the URD and SRD will form an embryo of the BC. By Main Gate, it should be possible to set User and Systems Requirements, the ISD and costs with confidence. The BC justifies the proposed procurement and includes the user requirement, and the procurement and support strategies. It takes account of work undertaken during the Assessment Phase and any trade-offs that have been made between performance, cost, time and

effective integration. At Main Gate the approving authorities need to think that continuing the project to Demonstration and Manufacture will give value for money.

The BC should describe any plans for incremental acquisition and technology insertion at later stages of the project. The BC should include robust analysis of how the total COO will affect value for money and affordability through the equipment's life. It must include a comparison of the COO of the recommended solution against the COO of any in-service capability. The BC should record the outcome of the assessment of defence industrial implications and discussions with the DTI. The impact of international law must be considered for all equipment programmes at Initial Gate, Main Gate and entry into manufacture.

Great store is set by the cost and time confidence figures. It is expected that they will be derived from a systematic and rigorous three-point estimating process and the application of appropriate risk modelling techniques. Therefore both Initial and Main Gate cases should include a description of the key risks and uncertainties which drive the spread in the confidence figures and the probability 'S' curves that underpin the 10%, 50%, 90% and Not To Exceed confidence figures for cost and time.

The IAB will seek assurance that any proposed investment in terms of the PCT envelope is both mature and deliverable. Evidence of adequate assurance should be demonstrated using MoD's review and assurance processes. For Cat A projects (valued at over £400M), the BC should include the following topics:

Investment appraisal	Legal
Affordability	Sponsored reserves
Benefits realisation	Industrial implications
Through-life management	Support solutions envelope
Risk and three point estimating	SMART acquisition and project governance
Technology and systems integration readiness levels	Historical trends analysis
Commercial	

All BCs must start with an Executive Summary that should typically invite the approval of the project proceeding to the Demonstration and Manufacture phases. It should:

- Set out clearly the approval sought and the key elements of the case, derived from the customer focus and supplier focus, to support the recommendation.
- 'Stand alone' – it will usually be the key document for circulation to the approving authority. For Cat A projects, it will usually form the basis of the ensuing submission by IAB to ministers.

Even the most complex BC should not be more than 30 pages in length at most, including annexes. Preparation of the case will be led jointly by the DEC and IPTL and should discuss the targets to be set in the Customer/Supplier Agreement between these to individuals. The following checklist (not exhaustive) shows the main headings and a summary of the factors in a BC that will be considered in

reaching a source-selection decision. The criterion for material selection should invariably be relevance (or possibly perceived relevance) to the case for purchasing a particular capability in a particular way. (**Comment**: Some items that are cost orientated have been omitted, as they are not considered relevant to the search for best value.)

1. The User Requirement – the customer focus.
2. Key Requirements and Measures of Effectiveness sought.
3. Procurement and support strategy – the supplier focus.
4. Risk assessment and management procurement strategy options.
5. Support strategy and project management.
6. Assessment of bids/bid selection.
7. Assessment of defence industrial issues – and any other 'wider' issues.

There are many detailed factors that need to be covered in any BC. These can be summarised as:

- Capability & numbers required:
  - Method of employment/application of equipment to platforms
  - Interoperability – other equipment/nations
  - Performance in potential environments
  - Needs of allies & NATO standardisation; interoperability with allies
  - Any arms control issues e.g. legality
  - Human factors
  - Training & simulation
  - Concept of analysis & measures of effectiveness for COEIA
- Achievement of reliability & maintainability/in-service reliability demonstration
- Basing
- Collaboration/MOUs needed & competition
- Contracting strategy & issues/break-points
- Contractor & in-house support
- Delivery programme
- Durability, testability, life expectancy & updates
- Environmental impact
- Evaluation process to enable learning from experience
- Government furnished equipment/facilities
- Impact of EU Supplies & other Directives
- Industrial loading/capabilities/employment/ technologies
- Integrated logistic support strategy/plan
- IPR
- Key points on industrial strategy & collaboration (as appropriate).
- Management arrangements/prime/sub contractors
- Performance, time envelope
- Procurement history – project progress to date; lessons learned from earlier phases
- Project management arrangements – cost-effectiveness & ability to deliver change
- Process ownership & accountability
- Purchase from abroad/overseas expenditure
- Reciprocal purchasing
- Relevant legislation/Health & Safety
- Reliability plan & maintenance philosophy
- Required availability, reliability & maintainability, & sustainability
- Risk analysis & mitigation strategies
- Sales prospects/implications
- Security
- System components/key sub-systems
- Trials, technology & demonstrators

The BC should be supported by analysis on a scale appropriate to the importance and complexity of the project. A COEIA should only be required at the concept stage if it is proposed to limit the options to be taken forward in the Assessment Phase. For Cat A, B and C projects, advance approval for a Concept of Analysis should be sought.

PFI project categories are determined on the same basis as for the underpinning capital asset (i.e. for equipment on the basis of the procurement cost). The introduction of Resource Accounting and Budgeting (RAB) does not affect the assessment of value for money. The way in which Investment Appraisals, COEIAs and Cost Benefit Analyses are constructed and presented is unchanged by the move to resource-based approvals.

In preparing for the Main Gate, a COEIA is a vital part of the decision-making process. A clear, succinct account of findings, and how they have been taken into account, should be presented as part of the BC. This points to the importance of the joint sponsorship of the COEIA by the DEC and IPTL. Both need to take a close interest in the planning and development of the work, and should ensure that the Economic Adviser's department, as well as the scientific staffs, are consulted at an early stage. The BC might also take account of a paper bringing together the results of the COEIA and other supporting operational analysis, if appropriate. The AMS recommends the use of the MACE 'Multi-Attribute Choice Elucidation' methodology tool [192] that is based on well-established principles or, for more complex tenders, the DOORS and AWARD software tools that implement the MACE methodology. These two tools were examined in Section 5.3.

Initial and Main Gate BCs for equipment projects should contain a structured assessment of the route map to maturity of the individual key technologies needed to deliver the defence capability required. IPTs should use the Technology Readiness Level (TRL) methodology,[193] as a means of assessing technology maturity. The IAB does not mandate particular levels of technology readiness that need to be demonstrated for approval but at Main Gate the levels of readiness including system integration of key technologies will be assessed.

1 Comment

It is apparent that the contents required in Business Cases covers everything that might be of value to MoD, and a few items that impact more widely. However, AMS instructions are specific that no weightings are to be given to items included in a Business Case that lie outside the scope of what is in the COEIA. This implies that value cannot be measured and therefore nor can value for money. However, here, for the first time, consideration is given to the assessment of defence industrial issues – and any other 'wider' issues. The approval procedure for the largest equipment project, shown in Figure 68 on Page 175, implies that ministers within MoD always make the final decision. However, MoD ministers regularly refer some sensitive major projects are up to the Cabinet for its decision, as mentioned in Section 8.7.1. Despite *Smart Approvals – Instructions and Guidance on IAB and*

Delegated Approvals Version 9.1 being issued eighteen months after the addition of 'effectively integrated' to have equal weight with performance, cost and time, the instructions do not reflect the importance of this key change.

7.3.14 Main Gate [194]

Main Gate is an exacting approval hurdle, which recommends a single technological and acquisition option. By Main Gate, risk should have been sufficiently reduced and the project should be sufficiently mature for User and Systems Requirements, the ISD and costs to be set with confidence.

The BC should provide a full justification for the proposed procurement taking full account any trade-offs that have been made within the PCT envelope set at Initial Gate. At Main Gate the Approving Authority must be satisfied that the continuation of the project to Demonstration and Manufacture represents value for money. The customer will need to be satisfied that the highest acceptable cost is affordable.

If usual Main Gate confidence levels cannot be demonstrated for the entire programme, subsequent approvals may be needed for those increments where the risk is deemed too great at the main decision point. The approval category for Main Gate in these circumstances will, however, continue to be determined by the overall cost of the programme, not the value of the first basket of increments.

7.3.15 Through-life Management Planning

An integrated through-life approach to managing projects is a key tenet of Smart Acquisition. This approach should start as soon as the DEC identifies a capability shortfall and should continue throughout the CADMID cycle. A Through-life Management Plan (TLMP), with a level of detail commensurate with the overall value and complexity of the project, should be drawn up in consultation with other stakeholders as soon as the project is initiated, and should be updated and refined as the project progresses. The Cost of Ownership (COO) offers a means of highlighting affordability and budgetary implications once the new equipment enters service. The COO comparisons will enable the IAB to assess the resource consumption implications of the proposed acquisition. Whole-life Cost (WLC) estimates should include all attributable direct- and indirect-resource costs associated with procurement, operation and support. The Support Solutions Envelope (SSE) was developed by DLO to ensure projects take account of defence support-chain corporate needs. The requirement to judge a support strategy against the SSE is a mandated process for all IPTs and the fact that the support strategy is compliant with the SSE, or otherwise, must be clearly stated in the Business Case.

7.3.16 Incremental acquisition [195]

The AMS defines incremental acquisition as: '*An approach to acquiring military capability in which successive equipment increments, albeit flexible in detail, are planned within a scheme of known overall capability requirement and affordability, with each increment providing quantifiable free-*

standing military capability.' It is a key element of Smart Acquisition and its objectives are to '*replace the current MoD acquisition process by one based on acquiring military capability progressively, at lower risk, and with optimisation of trade-offs between military effectiveness, time and whole-life cost*' and '*cut the time taken for key new technologies to be introduced into the front-line, where needed to secure military advantage and industrial competitiveness.*' Incremental acquisition must be funded from the outset and it is not intended to include long-term capability improvements such as mid-life upgrades, updates or product-improvement programmes to existing equipment.

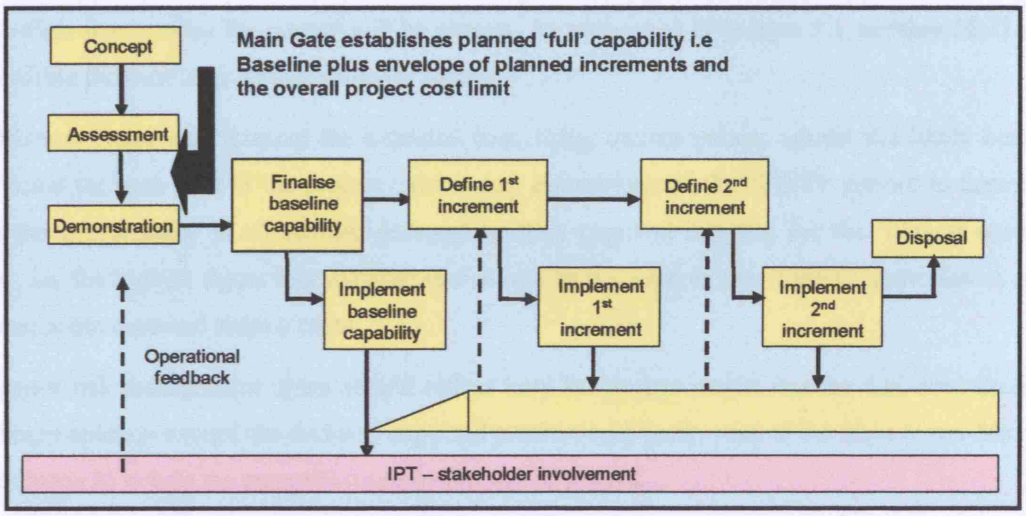

Figure 72 Incremental acquisition has a significant probability of improving value for money.

Comment: How might incremental acquisition affect the achievement of best value for money? Clearly the technical risk will be reduced and new and evolving technologies should be delivered sooner, albeit at a lower but acceptable capability level. The pre-planning of technology improvement increments will enable capability to be upgraded in what appears to be a cost-effective manner.

7.3.17 Affordability [196]

While cost is not a factor in this research, affordability is likely to impact on the achievement of value for money. As budgets derived from the EP and STP are set in resource terms, it follows that project affordability must also be established in resource terms. There are two clear elements to affordability, 'Procurement Affordability' and 'Through-Life Affordability'. Procurement affordability demonstrates whether the resources required to purchase the asset or service can be contained within existing control totals. Through-Life affordability is an assessment of the longer-term consequences of owning, operating, supporting and disposing of the asset. This will involve the generation and comparison of COO statements showing the resources consumed or planned for each year of a project's life.

By Main Gate, all top-level budget (TLB) holders affected by the project need to have identified all the capital and operating costs associated with the project through life, including the savings from equipment or infrastructure being replaced and/or any transition costs. Projects must present the

expected cost, using outturn prices, against the likely budgetary provision for each year of the project (which may extend beyond the EP/STP period) for each TLB holder.

1 Comment

Affordability does in some ways contradict the aim of achieving best value for money, as what is affordable may not offer best value for money. It can be argued that MoD can afford anything it needs; its problem is that it cannot afford everything. The potential impact of the inclusion of affordability as a criterion is that if the bid that offers best value for money is not affordable, then a cheaper solution that offers worse value for money will be chosen. As mentioned in Section 3.1, perhaps MoD should be seeking the most appropriate value for money.

Business Cases must present the expected cost, using outturn prices, against the likely budgetary provision for each year of the project (which may extend beyond the EP/STP period) to demonstrate that the procurement is affordable. Although project approval is given for the 'highest acceptable cost', i.e. the highest figure that the customer would be prepared to pay, EP/STP provision in general represent the expected project costs.

Project risk-management plans should reflect how the project would best be delivered should the optimum solution exceed the declared expected procurement costs – one of the aims of pre-Main Gate work being to reduce the potential through-life cost of project.

7.3.18 Customer/Supplier Agreements

The DEC is responsible for ensuring that the contributors of the elements of military capability know what is required of them. The contributions are specified in Customer/Supplier Agreements between the DEC and the other organisations concerned. (In practice, there may be a single Customer/Supplier Agreement, containing different sections to show the agreed deliverables, drafted and managed by the IPTL on behalf of the DEC.) The DEC is not responsible for the delivery of these outputs.

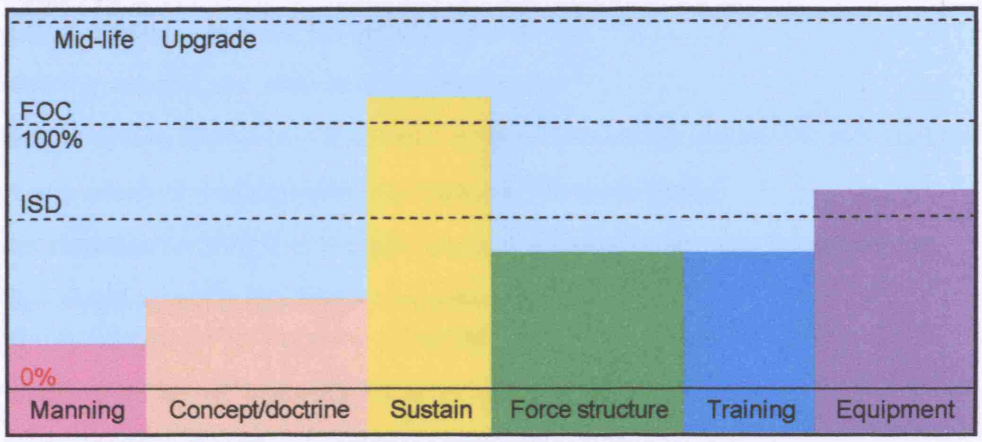

Figure 73 The elements of capability at a specific point in a programme.

In measuring the degree of capability achieved, the baseline is the expectation set by the URD. Figure 73 illustrates the various elements of capability at a point in a programme. Some elements may

be more mature than others; indeed, some may need no enhancement being inherited from or underpinned by other programmes. Full Operational Capability (FOC) is what the DEC is buying in terms of capability, contracted within the bounds of the SRD. FOC is available when all elements reach 100%, with In-Service Date (ISD) also shown as a straight line; in reality ISD may require differing percentages for each element. ISD is declared when the military capability provided by the system is assessed as available for operational use (in its minimum usefully deployable form). As such, it is the date on which an Initial Operating Capability (IOC) is achieved.

7.3.19 Risk Identification

The Risk Identification Prompt List (RIPL)[197] is not a checklist nor exhaustive; its purpose is to prompt initial thought and provide creative stimuli to identify project risks. The risks divide into four main groupings:

1 ***Contractor issues***

a. Using discrete suppliers for design/development and production, or for interfacing/integration.

b. Depending on trade agreements/licensing arrangements.

c. Dependency/non-dependency of supplier on MoD work/non-MoD work now and/or in future.

d. Contract won as a result of hard competition and cost cutting and/or awarded to lowest bidder.

e. Programme dislocation from supplier take-over/rationalisation/relocation or industrial relations.

2 ***Supply issues***

a. Lack of contingency supplies/stockpiling of scarce materiel.

b. Use of proprietary material (specified by trade name, no technical specification available).

c. Low volume military-specific use only.

d. Market dominated by other (non-military) users of materiel.

3 ***Political issues***

a. Potential adverse changes in UK political climate.

b. Political events that may introduce changes in policy.

c. Potential adverse changes in UK defence, environment, foreign, financial or industrial policies.

d. Adverse effects of pending legislation (National, EC and overseas).

e. Possible limitation/disruption in supply due to developing industrial/political situation.

4 ***Foreign suppliers and collaborative programmes***

a. Stability/volatility of collaborative partner markets.

b. Variability in National Standards and practices.

c. Potential adverse changes in overseas governments.

Comment: Many items on the list are unsurprisingly concerned with the various areas of scientific/technical risk and others deal with contractual or financial aspects. Some of the risks can be

quantified by the application of SIBET. The remaining risks listed appear to fall outside the many evaluation criteria used by MoD. The supply issues, listed in Paragraph 2 above, apply regardless of which contractor is selected. Most of the other risks are extremely difficult to quantify, particularly as they depend on how contractors, markets or political issues change over the life of a project. Some still apply to all suppliers, though others, particularly those in Paragraph 4 above, will have different effects on potential suppliers depending on the contractor location.

7.3.20 MoD/Industry Commercial Policy [198]

MoD shall strive to deliver value for money from the defence budget by managing its acquisition processes efficiently, while understanding suppliers needs to be profitable and give shareholder value. Suppliers shall:

- Strive to deliver value to the MoD.
- Make known their capabilities, strategies and alliances to enable MoD to form an adequate assessment of the supplier's capability to satisfy MoD forward needs.
- Assist MoD in devising realistic budgets for acquisition programmes, highlighting options to trade-off timescales, quality, operational effectiveness and/or cost.

1 Comment on MoD/Industry Commercial Policy

While this policy strives to recognise some of the issues that suppliers face, Figure 74 has been developed to show the eight drivers that impact on shareholder value. These need to be recognised by those involved in MoD acquisitions. Furthermore, it is difficult for MoD to ensure that suppliers respond to all of its desires.

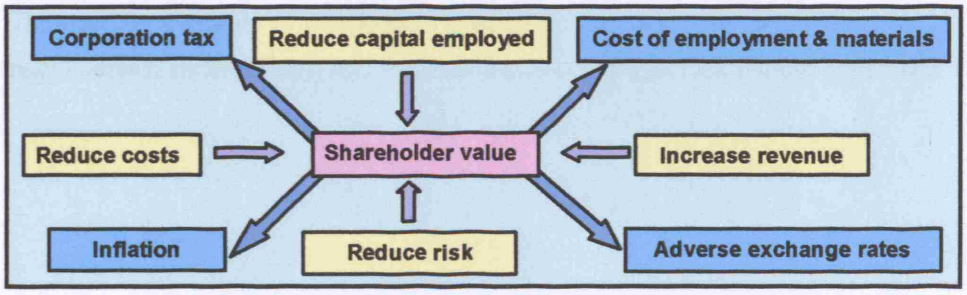

Figure 74 Shareholder value is affected by a variety of factors.

7.3.21 Comment on the AMS

There is no question that the content of the AMS is an enormous asset to anyone involved in any stage of acquisition. Its advantages are its breadth of cover and the fact that as a set of soft documents, they are easily updated. The AMS supports the Smart Acquisition initiative but appears to have grown 'like Topsy' and some streamlining of the system would help users better to understand acquisition procedures. Its shortcomings result from the inevitably huge number of documents and, as acquisition policy is spread amongst many parts of the system, it is hard to find the right document needed for any particular purpose; and some conflicting guidance is given. Restructuring could enhance acquisition

users' understanding of it. An improved search engine would speed up the process of finding required information and would also help to find key topics which are often not listed in the AMS index.

Soft issues, contract terms, industrial issues, risk management arrangements and other wider factors could to advantage have greater precedence as could the fact that their effects vary depending on the selected contractor. The requirement to highlight the wider factors in Business Cases, rather than analyse them using weighting and scoring techniques, increases the difficulty of decision-making. Affordability must be recognised as conflicting with obtaining best value for money and the achievement of most appropriate value for money might be a better aim. In addition:

1. Budget constraints and incorrectly set budgets can easily mean that the best value for money solution is not affordable.
2. The use of MACE and SIBET software programs to assist in bid evaluation is not mandated.
3. The split in responsibility of DPA and DLO, and their IPTs, (respectively in charge of the initial purchase of equipment and its through-life support) may result in biased selection criteria to ensure either minimum initial price or most cost-effective maintenance and support. This militates against best value for money solutions.
4. 'At lower risk' could beneficially be added to existing four aims of Smart Acquisition.
5. In COEIAs, when considering cost effectiveness, cost has a clear relationship to money, while effectiveness is a part of what provides value. COEIAs could to advantage consider:
    a. The proposed solution's performance in peacetime.
    b. The near impossibility of establishing whole-life costs, given the long in-service life many major defence procurements and the problems of estimating costs far into the future.

8 VALUE ISSUES FOR MOD

There are several value issues that need to be examined from the viewpoint of MoD. These include the various sources of value for MoD, who gets value and the significance of the various different roles, the impact of political acquisition decisions, how value changes with time, any value in getting more than has been requested, the impact on value of capability requirements and budget setting, the effects of short-term attitudes and finally dealing with individual bias.

8.1 What are the various sources of value for MoD, including operational value?

8.1.1 For MoD as a whole

MoD states the factors they consider in bid evaluation are:[199]

- Operational effectiveness. (Better – In various environments is important but not mentioned.)
- Delivery timescales: ISD – Initial followed by Full Operational Capability. (Faster.)
- Effective integration. (More effectively integrated.)
- Estimates of whole-life costs. (Cheaper – This is the money issue.)
- The evaluation of risk.
- The ability to compete future requirements.
- Any risk of loosing a very small number of capabilities that for national security reasons should be retained within the UK industrial base.
- Wider factors taken into account:
  - Security of supply.
  - Certain key technologies.
  - Future export potential.
  - Industrial participation.
  - Factors that raise legal issues or are affected by MoD's environmental, security, personnel or estates policies.[200]
  - Desirable industrial capabilities impacting on the UK industrial base for defence reasons or the high value they bring to the industrial economy:
    - Potential in world markets.
    - Extent of generating economic activity of a high value-added.
    - Transferability into wider commercial applications outside defence.
    - Impact on regional industrial activity (including UK jobs created/sustained).
    - Any implications for foreign and security policy interests.

1 Comment

Clearly the inclusion of these factors when measuring value is necessary. The question is: are these factors sufficient? Ignoring the cost or money side, operational effectiveness is not defined. While for platforms, parameters such as speed, range, load carrying capacity and weapon effectiveness are obvious factors, other sources of value worth considering are:

- Deterrence of potential enemies.
- Ability to take advantage of changes in technology.[201]
- Contract terms and conditions.
- Intellectual property rights.
- Contractor soft issues (using SIBET as part of the evaluation of risk): [202]
  - Economic and financial standing.
  - Technical capability:
    - Education and professional qualifications.
    - Similar type of experience over last 3 years.
    - Staff turnover.
    - Equipment to provide services.
    - Sub-contract elements.
    - Technical support.
    - Quality.
    - Research and development.
  - Ability:
    - Skills.
    - Efficiency.
    - Experience.
    - Reliability.

What is clear is that the various sources of value can be divided into those for which there is objective data and those for which predictive evidence must be used. Furthermore, the factors any MoD evaluation team chooses to employ when measuring value for a particular tender assessment will be unique to that particular evaluation; the same factors cannot be applied to all bids, not least because the capability required will differ. There is also the question of where potential contract cancellation costs and the financial value of a warranty lie; these are both money issues but not a part of the price.

8.1.2 Department considerations

The values of EC, DPA and DLO naturally differ. EC is primarily interested in the timely delivery of the required capability at the minimum cost, while DPA is concerned with minimising the risks in contracting to obtain the capability required by EC. DLO worries about ease of support and LCC. Contractor Logistic Support (CLS) Guiding Principles [203] makes the interesting observation that '*the solution should provide optimum VFM for the MoD not just the IPT.*' MoD's primary objective in assessing competitive tenders is to get best value for money and the MoD Contracts Manual [204] states that normally the lowest satisfactory tender should be accepted. What exactly 'satisfactory' means is not defined. However, in deciding which tender will give the best value for money: '*not only price but*

also delivery, performance, quality, life of the equipment, spares requirements, after-sales servicing and perhaps other relevant matters need to be taken into account.' This is hardly a comprehensive list of all the other factors that should be considered.

Figure 75 has been produced to indicate how the factors to be considered and the stakeholder involvement vary as a major project moves from bid submission to contract.

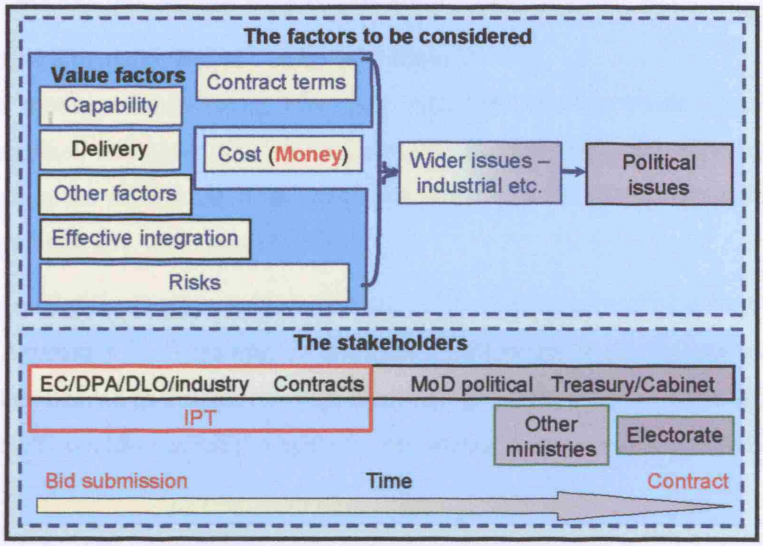

Figure 75 The various stakeholders have different concerns in choosing the best value for money solution.

SIBET shows it is possible to integrate the scores of individual contractors for technical compliance, commercial compliance and soft issues into a single score for each bidder. However, it appears that a systematic approach with suitable software tools is only taken independently for technical compliance, using MACE, Telelogic DOORS® or Commerce Decisions AWARD and for soft issues using SIBET.

8.1.3 Individuals bias

Although MoD tender procedures aim to minimise individual prejudice, these can never entirely be eliminated. However, the formation of an acquisition stream[205], and training staff working in IPTs on the AMS processes, should help to reduce personal bias. Individuals in IPTs, assessment teams and the IAB will all have particular views, based on their position in the various departments of MoD and their individual backgrounds and experience. Some of the factors that affect individual considerations are:

- Past history and experience.
- Domain knowledge or lack of it.
- Personal achievement/career progression.
- Individual recognition.
- Growth of the organisation.
- Financial reward and perks.
- A hassle-free and low-risk working environment.
- Attitude to risk [206]
- Prejudice.[207]
- Ignorance.[194]
- Fear of failure.[194]
- Over conformity.[194]
- Ethics.
- Mood.

For any individual, some factors will be more important than others. Clearly their relative import is likely to vary between civil servants and uniformed service personnel as it is between engineers,

scientists and administrators or between graduates and those without degrees. There is a danger of stereotyping groups, yet civil servants have are reputed to avoid risk and seek a hassle-free life.

8.1.4 What value are the UK and European defence industrial bases?

Getting short-term best value for money often involves procuring equipment from overseas. Such action with, for example a US supplier, can erode the UK or European defence industrial bases in research, development and production. So what is the wider value of maintaining a home or European capability and how can this be added into any value model?

MoD's policy for the '*Maintenance of the Defence Industrial Base*' [208] is clearly defined both in its guiding principles and in Smart Approvals.[209] These require Business Cases to cover any impact on skills, processes, technology or plant needed to design, develop, produce, integrate, repair or maintain military equipment, on which the UK could reasonably expect to rely during a period of heightened tension, crisis or war.

It is important to maintain industry's ability to support military operations and to regenerate critical equipment stocks in crisis and war. The impact of the UK's ability to continue should be assessed in order to:

- Influence future collaborative programmes and provide significant medium/long-term industrial contributions to these programmes.
- Minimise cost/operational penalties for in-service support of existing or future systems.
- Meet unique national commitments and maintain identified critical technologies.
- Meet MoD requirements through competition.
- Avoid significant shifts in the balance of defence trade.
- Achieve defence export sales and sustain overseas in-service support.

Whether this is possible in a fast changing defence industrial environment, where there is a single dominant UK defence contractor (BAE Systems) that already gains more than half its business from the US, is open to question.

8.1.5 What are the values of exports and commercial spin off?

Exports sales of equipment, developed for MoD under contract, result in royalties being paid by the contractor to the Treasury. It is, perhaps, unfortunate that these sales provide no direct benefit to MoD except in lengthening production and thus equipment support. They do, however, provide value to the nation. Desirable industrial capabilities in terms of exports and commercial spin off are stated to include: [210]

- Potential in world markets.
- Transferability into wider commercial applications outside defence.

The question is 'What weighting is placed on these two sources of value?' DESO is responsible for the first point and is a stakeholder in major procurements. The latter does not appear to be considered.

8.2 Do capability requirements or budget setting affect value?

It is well understood that it is the last few percentage points in any capability that can make a compliant solution inordinately expensive. Paradoxically, however, those last few points may also give a decisive military advantage, albeit at a price that may be viewed as unaffordable. It is therefore necessary for those working in EC to discuss with potential suppliers how far the various aspects of a capability statement may be pushed before the resulting technical solution becomes too expensive.

It is equally clear that too small a budget may result in a very inferior solution or inadequately-sized force. This is illustrated in Figure 76. Thus budgets must be established with care to ensure that they are adequate for the capability required. This again requires discourse with potential suppliers while, at the same time, making sure that suppliers are not suggesting too low a price just to get themselves into a favourable position on the bidder's list. It is unfortunate that neither the demands for too great a capability nor the allocation of too small a project budget appears to offer best value for money.

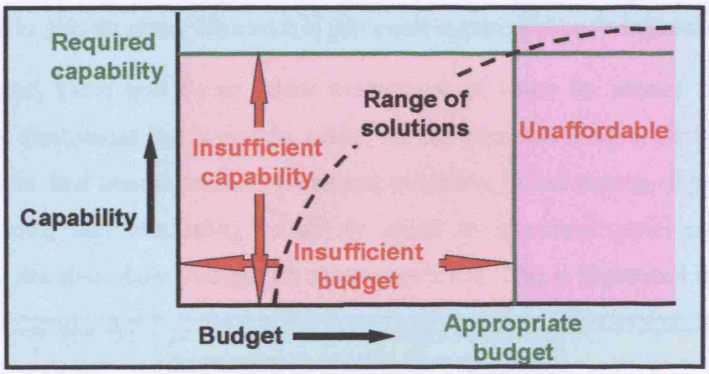

Figure 76 Care is required in deciding the required capability and setting an appropriate budget.

8.3 What is the value, if any, of getting more than has been requested?

There will inevitably be occasions when an offering will exceed the capability required. This is likely to be the case when latest technology or off-the-shelf solutions are proposed. So how does MoD value such excess capability? A thorough search of all the literature suggests that the answer is 'not at all.' Yet an unexpected excess capability (often due to a novel offering) may provide a battle-winning capability and, if it is ignored, that excess capability is likely to be available to potential enemies. Thus, in such circumstances, the original capability requirement may need to be reviewed.

8.4 How does value change with time?

8.4.1 How does value vary between peace and war?

In peacetime, the prime value of the armed forces and their equipment lies in their deterrent effect and as a form of insurance against aggression; be it terrorism or open warfare. In the last decade and a half, the Cold War has ended and the War on Terror has started. The armed forces also provide political

value to the government in international affairs, not the least as they support the UK's position as a permanent member of the UN Security Council. They also help in the nation's ability to provide overseas support in terms of humanitarian aid, peacekeeping duties and countering aggression.

In peacetime, equipment will be tested as far as is feasible and affordable by training, simulation and exercises, but inevitably the severity of these trials falls significantly short of the full rigours of war. Furthermore, despite overseas deployments, it is hard to ensure that the survivable environmental conditions match those that will be found in a future war at some unexpected point on the globe.

In war, the value of equipment is crucial in providing the winning edge, and every piece of equipment is both subjectively and objectively tested through use. Equipment found to be wanting may be abandoned or rapidly replaced. Equipment falling into the hands of the enemy will normally lose its value as effective countermeasures are developed.

1 Technology changes and obsolescent equipment

Rapid changes in technology affect MoD's perception of the value of many equipment purchases. The latest technology yesterday is already obsolescent today and obsolete tomorrow. The breadth of technology change is also an issue. Nowhere is this more apparent than in information technology.

In source selection, there will be an initial assessment of value for money at Main Gate. When delivered, the new equipment has a certain value. As the equipment ages, its value reduces as new and better equipment, and countermeasures, become available. Some aspects of performance may also reduce until disposal, and worsening reliability allied to increased problems with maintenance (including its cost) are also likely throughout equipment's life. This is illustrated in Figure 77.

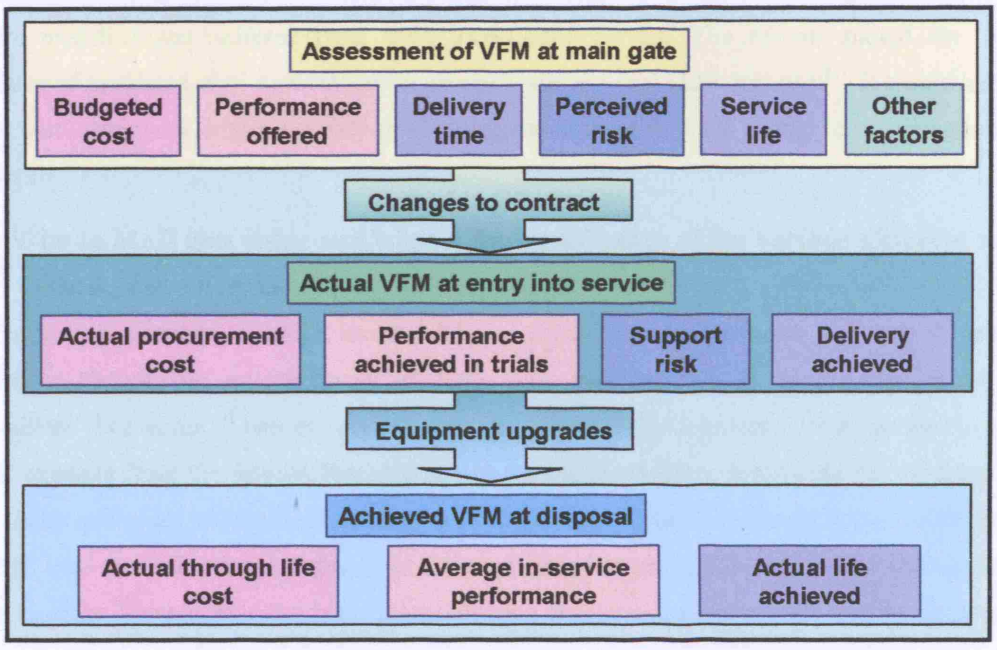

Figure 77 Factors affecting value for money (VFM) change with time.

8.4.2 Culture

Cultural changes can impact on defence equipment almost as much as it can in consumer markets. This is particularly true in an era when possible technical solutions far exceed the budgetary capability to procure them. Thus, particular pieces of equipment may be seen either to represent better value for money, or may even be prohibited by international treaty. Why, for example, does the UK presently refuse to issue its troops with jack-boots? Such boots are less prone to let in water than conventional one, but their use has been based here on images of Nazi storm troopers goose-stepping in jack-boots. Thus, the improved performance of jack-boots is negated by their unacceptable cultural impact.

8.4.3 Competition and other laws

In the UK, a raft of laws impact on competition, not to mention EU law to which UK law is subsumed. Laws are ever changing to take into consideration factors like protecting the environment and health and safety at work. In addition, certain international treaties impact significantly on UK defence systems, such as the current nuclear test-ban treaty and the prohibition of anti-personnel mines.

8.5 How is value affected by short-term approaches?

Two different classes of short-term approaches are considered here. The first is where a new item of equipment is suddenly and urgently required and time is of the essence. An example might be the sudden onset of irreparable structural fatigue to a fleet of aircraft and the need for rapid replacement. The other class of short-term approach is where a better solution with lower whole-life costs is rejected in favour of an alternative that has a lower initial cost despite higher running costs. A recent example of a short-term approach was the deployment of Challenger 2 MBTs to Oman on exercise without suitable engine dust-protection measures. NAO reported that the Challenger 2 without desert-warfare modifications suffered from 30% unavailability rates. The reason quoted for the high incidence of problems with these tanks on exercise was the cost (£20 million).[211] It would be hard to accept that losing such a high percentage of an armoured force for such a small cost saving was value for money.

8.6 Who in MoD gets value and what is the significance of the various different roles?

8.6.1 Whose cost, whose value?

The budgeting process in MoD largely defines which department bears the cost of any new acquisition, though the apportionment of some costs may be arbitrary in the case of tri-service acquisitions. The value, however, may or may not lie with the department that carries the cost. A classic example from the Second World War was the procurement of petrol cans for the army. These were cheap and prone to leak badly, but it was not the supply branch of the army that suffered. It was the teeth arms that often faced a chronic shortage of fuel. The capture and use by the teeth arms of the vastly superior German jerry can led to a specification change and a better value can for the users.

8.6.2 Stakeholders[212]

The AMS acquisition stakeholder good practice model illustrated in Figure 78 shows only six groups of stakeholder.[213] On the other hand, the AMS also provides the following list of the stakeholders during the CADMID cycle in its set of stakeholder function diagrams.

- Chief Scientific Adviser Technical Scrutiny.
- Scientific Intelligence.
- CRP & ARP Scientists.
- Director Force Development.
- Industry.
- DPA.
- DLO.
- IPT (part of DPA or DLO).
- Equipment Capability Customer.
- Second Customer Front Line Commands.
- Head of Defence Export Services.[ddd]

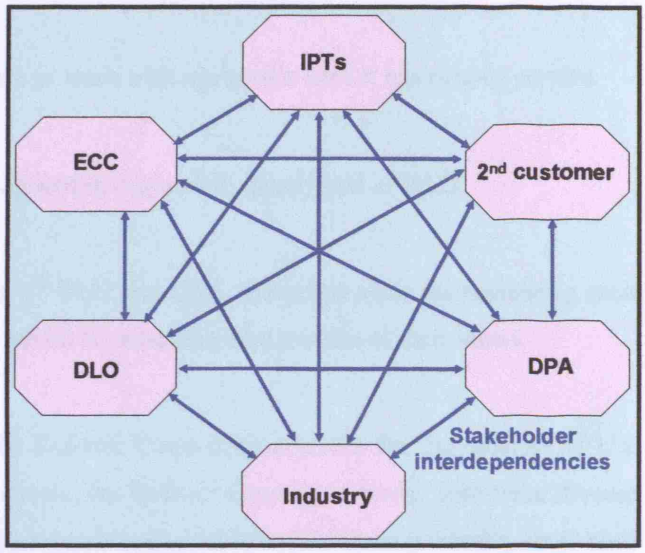

Figure 78 The AMS shows just six stakeholders in the acquisition process.[214]

Neither list seems comprehensive, so which stakeholders are missing? MoD management and the IAB are not mentioned, nor are other ministries particularly the Treasury, Parliament or the Cabinet. Neither is there any mention of the general public who provide the funding via taxation. Further-more the media affects the majority of stakeholders. Figure 79 has been devised to illustrate some other groups that may influence major acquisition decisions.

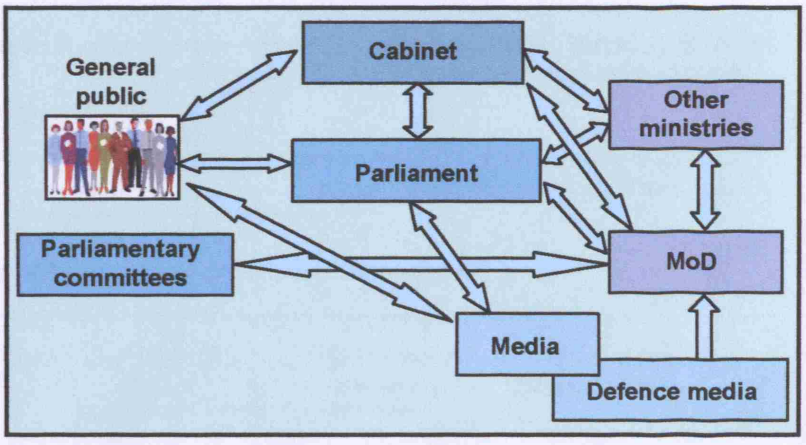

Figure 79 Some of the groups outside MoD that may impact on acquisition decisions.

Another way of looking at stakeholders is by considering their role in relation to acquisition and this is now examined.

[ddd] Presumably not in person but representing his organisation.

1 Specifiers

Specifiers work in Equipment Capability and have to define future capabilities. They are drawn from the user community. Scientific intelligence and research scientists provide specifiers with inputs.

2 Procurers

Procurers are those people, uniformed or civil servants, who work for DPA. However, once equipment enters service, this responsibility passes to staff in DLO.

3 Users

Users in the front-line commands wear, operate or work with equipment once it has entered service.

4 Supporters

The people responsible for maintaining and supporting equipment, mostly part of DLO.

5 Scrutineers

Nominated 'scrutineers', acting on behalf of 2nd PUS and CSA, are responsible for reviewing each Business Case and advising any changes that would be needed to take account of their views.

6 MoD management [215]

The Secretary of State for Defence heads the Defence Council, responsible for the conduct of UK military operations. Unlike industry and commerce, the Defence Council is drawn from three diverse groups. At the top are four politicians; while below them is a minimum of three (currently four) civil servants and at least five (currently six) members of the armed forces, the last drawn from all three branches. The organisation of the Defence Council[eee] is shown in Figure 80.

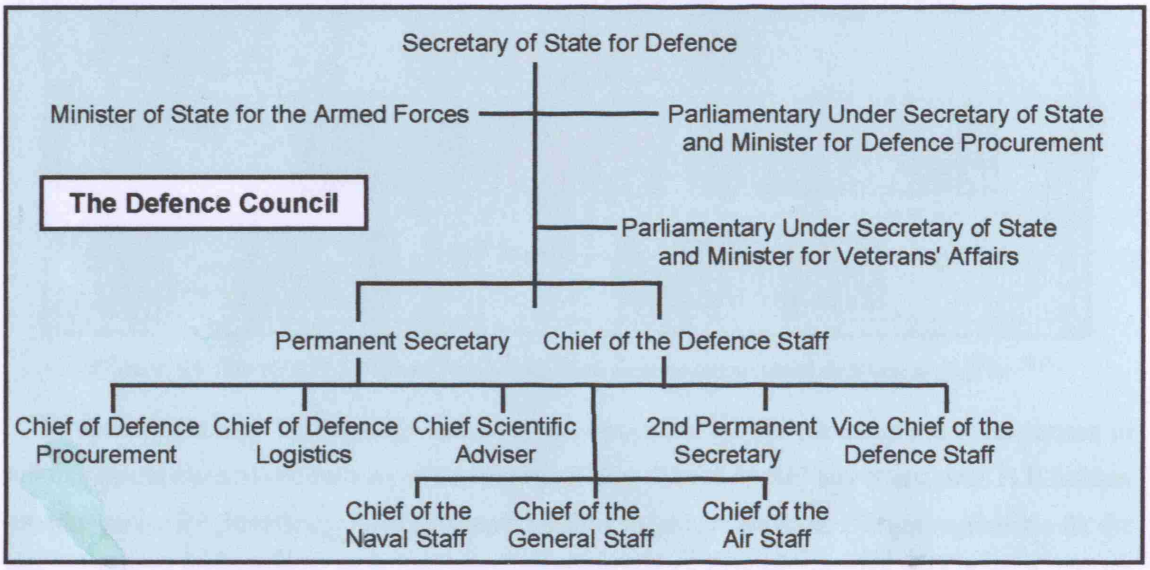

Figure 80 The legal basis for the conduct of defence in the UK rests with the Defence Council. [216]

[eee] As of August 2005.

The Defence Management Board is the executive board of the Defence Council and is responsible for directing a number of key processes, in particular the annual re-costing of the defence programme and the departmental planning process.

Permanent Under Secretary of State – Joint chair – Chief of the Defence Staff	
2nd Permanent Under Secretary of State	Vice Chief of the Defence Staff
First Sea Lord & Chief of the Naval Staff	Chief of Defence Procurement
Chief of the General Staff	Chief of Defence Logistics
Chief of the Air Staff	Finance Director
Chief Scientific Adviser	Two Non-Executive Members

Figure 81 The defence management board presently has 13 members.[217]

Most defence activity takes place outside MoD 'head office' and is managed through eleven Top Level Budget (TLB) holders and four Trading Funds. The Permanent Secretary grants the TLB holders extensive delegated powers over their resources of cash, personnel and land.

The Central TLB has lead responsibility for the development of policy and strategy for the MoD and provides manpower for the Central Staff, which has an important role in performance management, ensuring policy decisions are carried out and making certain targets are being met.

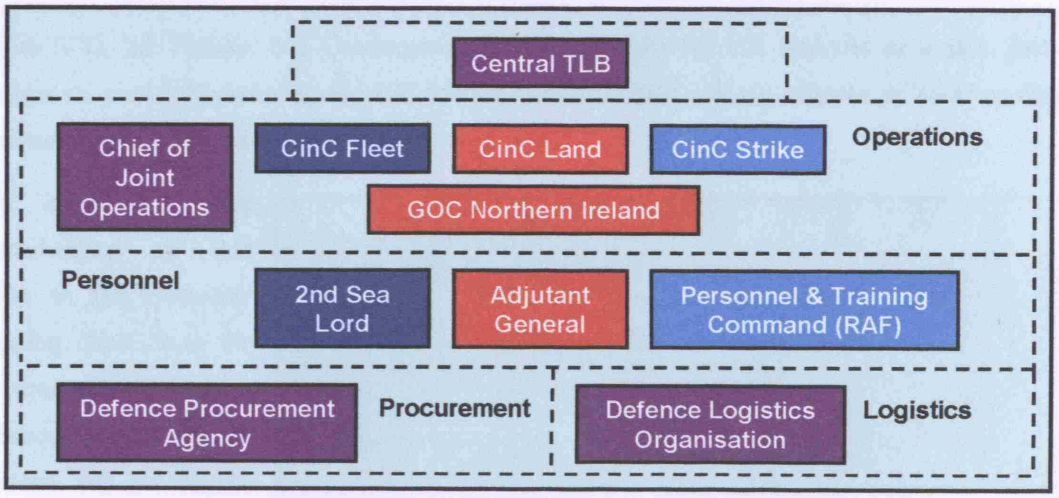

Figure 82 The eleven top-level budget holders that manage most defence activities. [218]

The five Operational TLB holders are directly responsible for the planning and management of military operations and the delivery of frontline capability. The three Military Manpower TLB holders are responsible for providing trained personnel for their respective services. DPA is responsible for the procurement of equipment to meet new requirements while DLO is accountable for logistical support to all three services to make the front-line services more flexible, more effective and more efficient.

Direct access to people in the Defence Council, Defence Management Board and TLB holders, to garner their views on value for money, proved not to be a practical proposition.

8.6.3 Who else might get benefits?

Three other groups may get benefit from MoD procurements. The first is the supplier. Apart from the work itself, which may enhance the company's profitability, capabilities, infrastructure and staff morale, there is often significant prestige and publicity for the winning company. However, these are not part of MoD's remit in source selection. Both DESO and the Treasury are potential beneficiaries should the resultant solution have export potential. While the benefit to DESO is in enhancing its 'order book' and its reputation with industry, these are not a consideration in source selection. Furthermore, any future revenue paid by industry to the Treasury as equipment royalties impacts on money rather than value and so is irrelevant to this research. There are other ministries that may be affected by MoD acquisition decisions. Some examples of them and their concerns are detailed below.

DTI, the Department of Trade and Industry has an overarching responsibility for the health of UK industry and overseas trade, working with businesses, employees and consumers to drive up UK productivity and competitiveness to deliver prosperity for all by promoting enterprise, innovation and creativity. It also invests heavily in world-class science and technology. [219]

DWP, the Department for Works and Pensions has to pay benefits to anyone who loses their job, for example when MoD places a contract with an overseas rather than a UK-based company. They thus have a distinct financial interest in the acquisition decisions made by MoD. [220]

The FCO, the Foreign and Commonwealth Office, works for UK interests in a safe, just and prosperous world. Maintaining the UK defence industrial base and the reliance of MoD on foreign contractors are both import to the FCO. [221]

It is worth giving consideration at this point to the customer/ supplier chain from the government at the top to component maker at the bottom. All get benefit from the acquisition of appropriate value for money solutions. Figure 83 illustrates the customer/supplier links from government to component supplier.

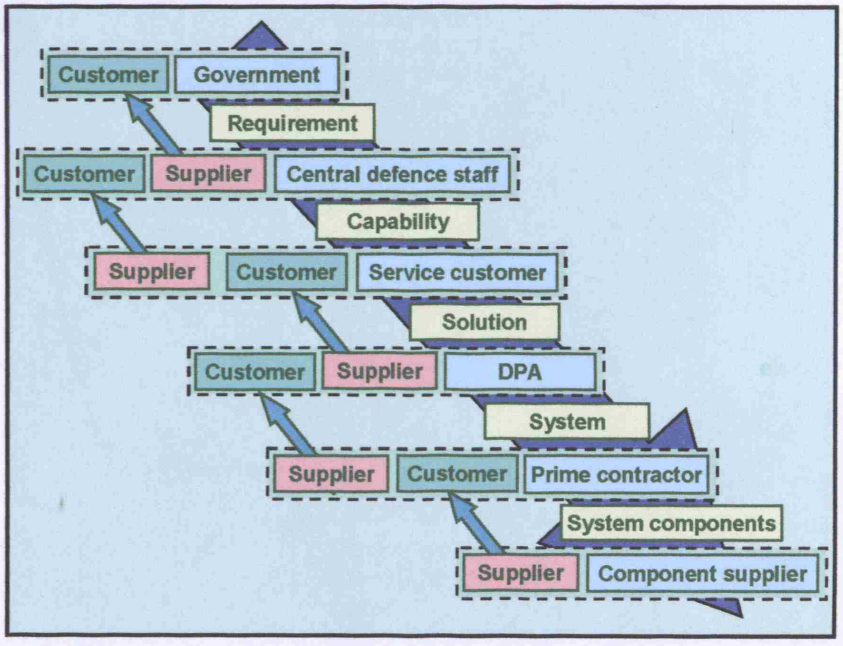

Figure 83 Those in government, in MoD and in industry are all part of the supplier/customer chain.

8.6.4 The evaluation team

Many factors impact on those involved in evaluating bids. These include which team is involved and when, the specialisation of team members, their seniority, affiliation, experience and personality, as well as a range of political inputs from a variety of sources. These are illustrated in Figure 84.

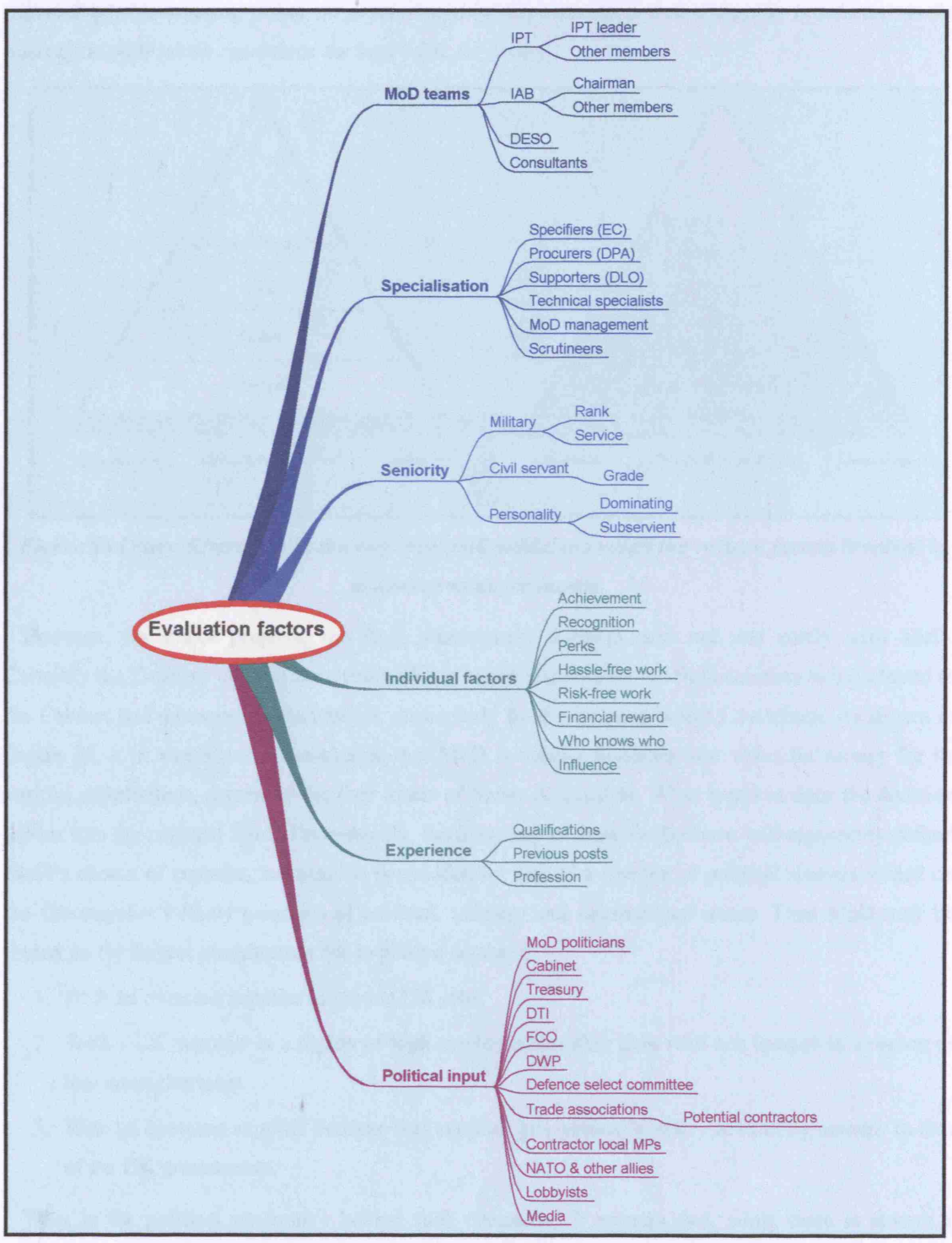

Figure 84 Who gets value and the relationship of the various factors.

8.7 What political issues can over-ride MoD's supplier selection?

An NAO document '*Getting value for money from procurement*',[222] co-sponsored by the Office of Government Commerce (OGC) states '*... a reinforcement of the principle that procurement by departments should be based on value for money*'. OGC's document on contractor selection [223] states: '*Accordingly Government policy on procurement by Departments is that a supplier is selected on the basis of an offer which represents the best value for money.*'

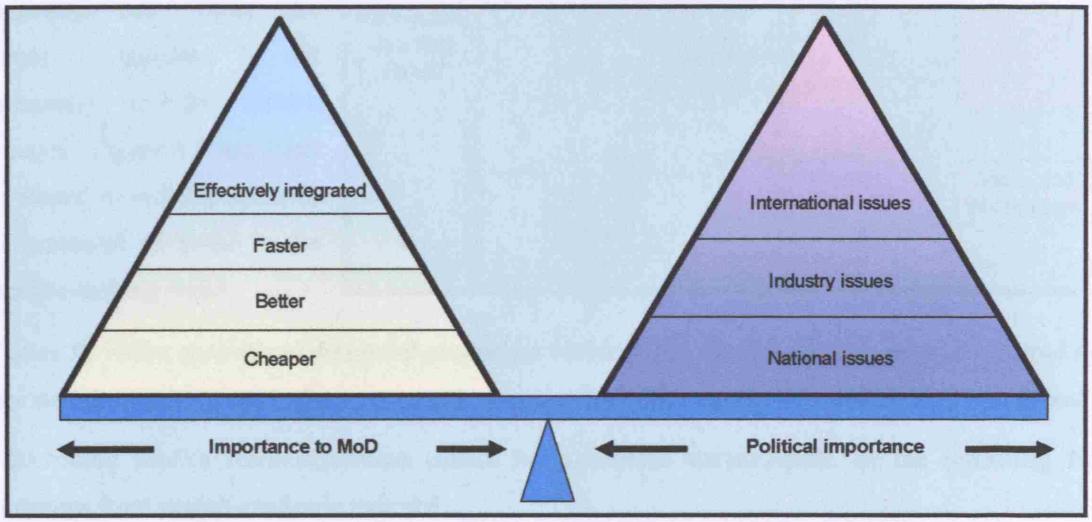

Figure 85 Likely differences in the way MoD and politicians weigh the various factors involved in assessing value for money.

However, for major projects, the final procurement decision may not rest solely with MoD. Certainly the Treasury will get involved, and it is not uncommon for the final decision to be referred to the Cabinet and discussed in Parliament, particularly by the Defence Select Committee. As shown in Figure 85, it is a reasonable assumption that MoD is aiming to obtain best value for money for its various stakeholders, driven by the four tenets of Smart Acquisition. What happens once the decision moves into the political field? Undoubtedly, the Secretary of State for Defence will vigorously defend MoD's choice of supplier, but may be overridden for one of a number of political reasons, based on the Government's likely priorities of national, industry and international issues. Thus MoD may be forced on the largest programmes not to place a contract:

1. With an overseas supplier to protect UK jobs.
2. With a UK supplier in a region of high employment rather than with one located in a region of low unemployment.
3. With an overseas supplier because that supplier government's policy is running counter to that of the UK government.

What is the political imperative behind such decisions? It appears that, while there is always a genuine concern for levels of unemployment, the primary motivator is to gain votes at the next

election. Thus, overriding MoD's recommendation offers value to the government of the day, the selected contractor, its employees and shareholders, but not to MoD, nor to MoD's suggested best value for money supplier, nor necessarily to the British taxpayer. Figure 86 has been developed to indicate some of the pressures on those in the decision-making chain.

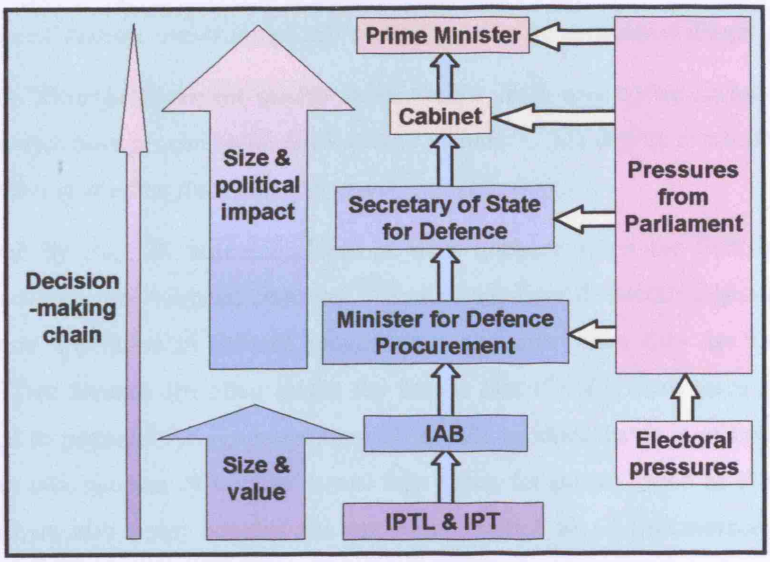

Figure 86 There are defined delegated authorities within MoD, but the decision may be referred up the decision-making chain for reasons that may not have been apparent when the ITT was issued.

Overriding MoD's recommendation cannot be considered unreasonable, as the following two quotations from British academia indicate.

1. '*However, no state makes defence acquisition decisions without regard to the wider economic and political consequences.*' [224]
2. '*Defence projects are procured with public funds and, as such, are constrained by the necessity of public accountability and by political considerations. Defence projects have many interested stakeholder organisations (Armed Forces, contractors, allies, taxpayers etc.) all of which have an interest in the project. Stakeholders may have divergent views on what constitutes success and how it should be achieved i.e. the armed forces seek capable equipment, contractors look for profits, allies expect complementary capabilities and taxpayers require responsible spending of public money.*' [225] It could be added that governments seek re-election.

The problem is that such political 'interference' does not offer best value for money to MoD, the subject of this research. MoD's attitude to political decisions on acquisition reinforces this problem. Those in MoD, as loyal servants of the Crown, must do as they are told. Thus the IPT will proceed with the chosen supplier, and NAO in its annual Major Projects Review has shown no sign of auditing political overriding of MoD's selection of a particular contractor or even whether the 'best value for money' solution was selected by MoD; rather it audits the progress of the project against plan.

There may be more serious consequences of political interference. Misfeasance in public office is a civil wrong or 'tort.' Such cases are extremely rare but can arise if, for example, a decision to down-select to a preferred contractor is based on tender-assessment criteria other than those published as part

of the tendering process.[226] Thus, unless the contract-selection criteria issued to potential suppliers include the various possible 'political' factors, over-riding MoD's selection may be considered illegal.

The World Bank states[227] that '*Poor procurement quality often results from underlying factors inherent in ... the organization carrying out procurement. Such factors include: ... the degree to which the procurement unit and the institution are free from political or other interference.*'

An interesting piece of research by two UK academics looks at what happens when the British government favours UK firms in defence procurement contracts.[228] Politicians have frequently argued that the government should favour UK firms in defence procurement contracts when they are in competition with foreign firms. Two reasons are often given; the first is that if a UK firm loses a contract, then this will be a signal to potential foreign purchasers of the UK product that it is of low quality; the second is the need to take account of broader issues than value for money, such as the impact on British jobs. The authors also point out that the argument applies to all procurement decisions where policy-makers – national, regional or local government – may want to favour a local firm To avoid such an outcome, the researchers suggest that the government should delegate procurement decisions to an independent agency that is only concerned about value for money.

8.7.1 A historical perspective

It is worth noting that the following also hold discussions on involvement in major-project approvals:

- Treasury
- FCO
- DTI
- Members of Parliament, the Government and the Cabinet

The final group consists of the politicians who serve in Parliament, be they MPs, ministers or members of the Cabinet. Major acquisitions by MoD often involve political debate and scrutiny. On occasions, MoD's choice of preferred supplier is over-ridden, sometimes with catastrophic results.

1 Nimrod AEW

The Nimrod AEW saga is indicator of the way the government of the day overrode MoD's selected choice of supplier. In this case, the lack of any value for the money spent became self-apparent. No working Nimrod AEW was ever delivered to the RAF.

> *By the end of 1974, instead of purchasing an off-the-shelf system with a proven track record, the Labour government predictably decided on ... the Nimrod AEW 3, accepting whatever extra cost and technical risk that involved. At the time the Labour government also considered that joining a possible NATO purchase of the Boeing E-3A was just too politically complicated, expensive and subject to unknown delay – which is rather ironic considering how things eventually turned out. At this point it was widely reported that the RAF was in favour of a dedicated UK purchase of the E-3A, rather than the Nimrod, but the cost, together with the potential loss of jobs in some marginal Labour seats, was always going to militate against this*

option. ... In 1986 the axe finally fell ... costing the taxpayer somewhere in the region of £1 billion for zero deliveries. In 1988 a Boeing proposal for the supply of 7 E-3D Sentry's was accepted and the aircraft eventually entered service in 199. [229]

2 Airbus A400M

An article by Airbus Industries [230] during the pre-contract phase of the A400 military transport aircraft urged governments to take a commercial approach and lampooned potential government customers' attempts to create jobs from military contracts. '*Sadly, the ability of governments to create jobs through government procurement is becoming severely limited because of international trade deals – but since "national security" is exempt from trade deals governments are free (encouraged) to use military spending to create jobs.*'

3 Canadian Sea King replacement

An example of political interference in Canada involves the replacement of its existing Sea King helicopters.[231] In 1992, a contract was placed for the EH-101 but the next year the new Liberal Prime Minister cancelled the deal with the supplier at a cost of $500 million in cancellation fees, arguing that the previous Conservative government was buying 'Cadillac' helicopters that were no longer necessary in the post-Cold War environment. The former project director of the current Maritime Helicopter Project wrote that that there: '*has been so much political meddling in Ottawa's bid to buy new naval helicopters that the winning aircraft could end up offering less performance than the 40-year-old Sea Kings they were slated to replace.*' He accused the Federal Government of sacrificing the need for a safe and highly-capable helicopter in an attempt to save political face. The Sea Kings were supposed to be replaced in the 1990s, then by 2005, but will now be kept until early into the next decade. The current Defence Minister has been pressed in Parliament to '*commit to eliminating political interference so that Canada can receive the best possible helicopter.*'

4 RN CVF

An ongoing major project is the requirement for two large aircraft carriers (CVF) for the Royal Navy. An interesting report [232] early in 2004 stated: '*The CVF IPT ... evaluation ... (showed) that the Thales proposal was technically and financially superior to the BAE proposal ... IAB discussed the report ... and finally endorsed a recommendation that the prime contract should go to Thales ... The MoD's preference for Thales leaked to the press ... BAE Systems responded with a major lobbying campaign and trade unions complained about the certain loss of jobs to France ... BAE fuelled the flames by "coincidently" announcing plans to cut 1,045 jobs in its shipbuilding business. But set against this was serious MoD dissatisfaction with BAE's performance on the already awarded Astute submarine and Nimrod maritime patrol aircraft contracts.*

... A small Cabinet sub-committee convened to discuss the CVF contract ... chaired by Prime Minister Blair ... It was agreed that it was politically impossible to award the contract outright to Thales (Defence Analysis ... claimed that the Prime Minister was influenced against Thales by his

disagreements with the French over Iraq and other major issues) and that a compromise solution involving both teams was necessary ... But as one MoD adviser put it: "After two years and millions of pounds, the Prime Minister appears to have decided to rewrite the deal in a week. I can see another disastrous compromise on the cards." ... The resulting agreement was announced in the House of Commons:

> *"Subject to detailed final negotiations, BAE Systems will take the leading position as preferred prime contractor, with Thales UK performing a major role as key supplier. The project will develop the carrier design put forward by Thales UK."*

It is now accepted by the MoD that the CVF Alliance (BAE Systems and Thales) will not be able to submit a bid for the Demonstration and Manufacture Phase that both meets the required specification (KURs) and is within budget ...'

This is still a developing situation. However, short-term political expediency has already been used once again to over-ride a professional IPT/IAB assessment. Only time will tell what the final impact is on performance, timescale and cost.

5 Industrial issues over-ride by Secretary of State for Defence [233]

Sir Richard Evans [fff] was critical of the process behind a decision in 2004 to select BAE Systems' Hawk fast-jet trainer to re-equip the RAF. This decision was held up by defence officials as a clear indication of the defence industrial policy in action: the Hawk won the non-competitive tender because not only did the UK need to retain a military aircraft manufacturing capability but such a move was also likely to secure lucrative export orders. Within days, India, after almost 20 years of postponing a decision, opted to buy a batch of 66 Hawks. But the decision to buy the Hawk was highly controversial, as it was only taken after Mr Hoon over-rode advice from his officials [ggg] as well those as from the Treasury, which had preferred an Italian aircraft.

8.7.2 Summary

It is clear that obtaining best value for money in defence systems acquisition is not straightforward. Numerous diverse sources of value and many different types of consideration have to be weighed against each other by groups of people driven by very different motivations. Even when the 'fastest, cheapest, best and most effectively integrated' solution has been selected by MoD, the resulting choice may still be over-ridden by political considerations, usually to protect British jobs, and end up giving worse value for money than the originally chosen bidder.

There are some interesting lessons to be learned from these cases, which impact on obtaining best value for money. The examples suggest that once an IPT, or its equivalent, has recommended a supplier's offering as best value for money, changing that decision for political reasons is likely to

[fff] Then Chief Executive of BAE Systems.
[ggg] Presumed to be the IAB.

reduce the value for money obtained both by MoD and the tax payer. Letting short-term political priorities over-ride professionally-made procurement recommendations appears not to be a good idea unless there are long-term strategically motivated reasons for so doing.

8.8 How is it best to deal with individual bias in actually judging value?

Individual bias can take one of two forms – positive bias or negative bias. Positive bias is where individuals apply bias based on their experience and role. Thus, the bias of a member of DLO in highlighting the value of good support is essential and positive. Negative bias is where the bias is more random and may, for example, cause an individual to undervalue an offering because a friend did not enjoy working for a company making an offer. Negative bias is a management issue for IPT leaders.

8.9 Stovepiping

The problem of stovepiping is particularly an issue for electronics equipment. As an example, the RAF operates a large fleet of aircraft and its strength on 1st April 2003 [234] was:

90 Tornado GR4	10 VC10 C1K	22 Merlin HC3
24 Tornado GR4A	45 Hercules C1/C3 and C4/C5	33 Puma HC1
52 Harrier GR7	5 BAe 125 CC3	20 Sea King HAR3/3A
9 Harrier T10	2 BAe 146 CC2	3 Griffin HAR2
40 Jaguar GR3	3 Squirrel HCC1	99 Hawk T1/T1A
3 Jaguar T4	29 Squirrel HT1	38 Firefly M260
91 Tornado F3	11 Griffin HT1	99 Tutor T1
6 Sentry AEW	4 C17 Globemaster III	67 Tucano T1
19 Nimrod MR2	8 VC10 K3/K4	11 Jetstream T1
3 Nimrod R1	8 Tristar K1/KC1/C2/C2A	9 Dominie T1/T2
4 Canberra PR9	34 Chinook HC4	1 Islander CC2
1 Canberra T4	1 Gazelle	Battle of Britain Memorial Flight

The list comprises nearly three-dozen different aircraft (including different marks). Some 14 different manufacturers designed these aircraft, more if the different companies such as English Electric, Vickers, Hawker Siddeley and de Havilland, all now part of BAE Systems are included). Assuming that each airframe and its engine(s) are customised, it leaves open the question of the value to the RAF of employing, for example, common avionics. Such an approach would simplify maintenance and minimise spares holdings but could, for any new aircraft, reduce performance, increase overall development costs and might prove impossible on internationally collaborative projects. Thus IPTs are unlikely to pursue such an approach although it could bring significant through-life savings. It would also require expensive re-certification of the whole RAF fleet each time a new item of avionic equipment was introduced into service. It may be that the recently introduced

Smart Acquisition epithet 'effectively integrated' may help here, but as an IPTL stated,[hhh] 'stovepiping is a service culture issue where the cost and benefits lie in different places.' Under Smart Acquisition, IPTLs and their IPTs are forced not to consider technical issues that lie beyond those of their particular project.

8.10 Can lessons be learned from other organisations?

In a report for the Food Standards Agency,[235] commenting on value for money, the text states: *'The Agency currently has no specific methodology for measuring value for money for research. At the reviews of the food safety programmes which preceded the setting up of the Agency, independent experts who participated were specifically asked whether the Government was receiving value for money from the research. Unfortunately, none of these felt that the mechanisms available at that time were robust enough to allow this question to be answered in an objective way. The current review has encountered the same problem. It therefore follows that some form of codified method for determining value for money is needed.'*

Bath and North East Somerset Council, for example, has a broad best value procurement strategy for services that is quite comprehensive in the information it provides, although not particularly relevant to MoD acquisition.[236] A public transport study by Hampshire County Council concluded: '*There is no effective way of measuring value for money.*' [237]

Mr (now Sir Peter) Gershon, then head of the Office of Government Commerce stated: '*Firstly, we have put in place ... an agreed methodology with departments and the NAO now that on an annual basis we are measuring value for money improvements out of government procurement expenditure.*' [238] Unfortunately, the OGC measure looks only at financial savings.

8.11 Public Private Partnerships (PPP) and Private Finance Initiatives (PFI) in MoD[239]

Partnership between the public and private sectors is a central plank of government strategy. MoD has identified four main PPP elements: outsourcing, strategic partnership between MoD and industry, selling into wider markets and PFI. Through PFI, the government is committed to seeking value for money from involving private-sector management expertise, innovation and capital investment in the delivery of services to the public sector and this is impacting on the defence acquisition process.

8.11.1 PFI

PFI involves the private sector in creating a new physical asset and selling a range of services to MoD built round the asset over an agreed time. MoD ministers have endorsed using PFI to provide services wherever appropriate, based on the principle of better quality services at optimal cost. Capability Working Groups should carefully explore, with IPTs, the scope for PFI and Partnering Arrangements as acquisition options from the start of the Concept Phase. Only if PFI has been demonstrated as unworkable, inappropriate or uneconomic should IPTs consider MoD capital-funding resources.

[hhh] See paragraph 8.12.4.

PFI aims to provide better value for money by allowing MoD to focus on its core tasks and achieve greater flexibility in programme and project planning, while benefiting from additional capital investment. PFI offers the potential for greater risk transfer (including demand, construction and residual value risk) to the private sector and is likely to involve rigorous project scrutiny by banks. PFI allows the private sector the opportunity to show innovation in the method of service delivery and places strong incentives on the contractor to deliver the service to time, cost and performance targets, as well as affording scope for the generation of third-party revenue.

PFI involves contracting for a service, with service-based payment mechanisms, where substantial capital investment is needed in an asset essential to deliver that service. MoD is determined to make best use of the private sector to improve defence services in support of front-line personnel. While the majority of these projects are outside the scope of this research, it is clear that some major operational military equipment may be acquired under PPP/PFI.

The challenge for MoD has been to develop PPPs that give good value in their own right and deliver significant performance improvements and efficiency savings. Unfortunately, while many ways in which cost can be saved are listed, in terms of improved value, the only mention of PPP is that one forged through negotiation may deliver value for money because the competition process provides a spur to perform and step forward with the optimum solution.

PFI is demanding but has realised savings of up to 40% in forecast costs compared with other forms of acquisition. However, PFI will not always be the answer and should only be considered where there is scope to achieve greater value for money than by conventional acquisition.

8.11.2 Benefits of PFI [240]

MoD claims that using PFI offers advantages over conventional capital-based procurement:

- Improved quality of service.
- Greater flexibility in project planning – Figure 87 shows the flat funding profile of PFI allowing a larger number of capital-intensive projects to be undertaken concurrently as costs are spread, and peaky spend profiles avoided. However, whether the orange area equals, is larger or smaller than the blue area depends on a range of factors and will be difficult to measure.

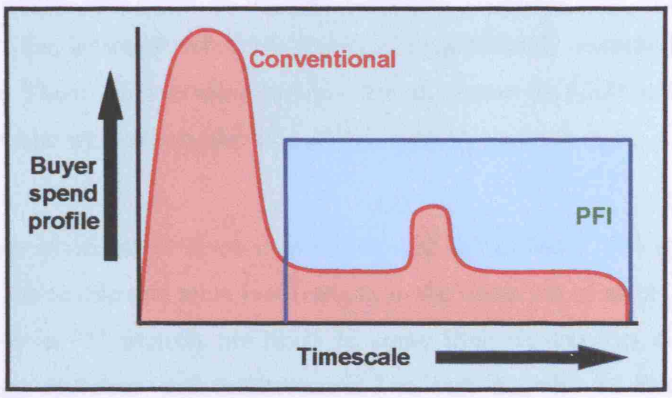

Figure 87 The contrasting cash profiles of conventional and PFI projects.

- Better allocation of risk.
- Better incentives to perform – The transfer of risk should give private-sector suppliers incentives to improve their management and performance on projects.
- Close integration of design and construction to service delivery. This should ensure:
  - Assets are fit for purpose but no more.
  - Applying existing expertise optimises the efficiency of assembly/operation.
  - Maximum benefit is gained from introducing new technology and business processes.
  - Asset design to improve resale value or capacity for transfer to new users at contract end.
- Best use of skills – PFI offers a clearer focus on the respective responsibilities of MoD and the supplier, which better reflect the strengths and skills of each.
- Generation of third-party revenues – There may be opportunities for the private-sector supplier to generate additional revenue from third parties.

Single integrated contracts provide opportunities for efficiency savings, the benefits of which can be shared between the supplier and customer.

8.11.3 Potential shortcomings of PFI

There is the issue of how far industry and its shareholders are interested in investing in a defence market that continues to take a shrinking proportion of government expenditure. There is also the question of whether the revenue justifies the investment. What happens in war is likely to become more of an uncertainty as this type of project moves closer to the front line (e.g. tanker aircraft).

While PFI clearly reduces MoD capital investment, at the same time it is likely to increase MoD revenue expenditure. This may become a serious difficulty as more and more acquisitions use the PFI route and will raise the question of whether PFI truly represents long-term value for money. Memories of the fashion for renting televisions in the UK during the second half of the twentieth century undoubtedly improved value for the customer; free repair of the then relatively unreliable sets and regular updating to new models. However this increased value was linked to a significantly increased cost, when compared to outright purchase. There will inevitably be some loss of control for MoD and there are politicians and members of the public who ask whether it is privatisation by the back door.

8.11.4 Types of PFI projects [241]

The only type of PFI likely in a defence environment involves services sold to the MoD. PFI is expected to lead to greater private-sector ownership and more involvement in the operation of assets, since many of the value for money gains in PFI projects are likely to come from the benefits of combining design, construction, on-going operation and maintenance. The vast majority of PFI prospects in MoD will be this type, with the MoD being the majority, or priority, user of the service.

8.11.5 Partnering

Partnering is essentially the development of new, much more co-operative long-term relationships between MoD and its suppliers for their long-term mutual benefit. The intention is to meet MoD's performance, quality and delivery requirements at the lowest possible through-life cost, and at a price that yields a fair profit. It involves both parties in addressing all aspects of the cost of doing business together and not just focusing on the unit price.

Partnering differs from conventional contracting relationships in that effective communication strategies amongst partners lead to trust, better and earlier identification and hence management of project risks, and increased value for money being gained in large-scale complex requirements. By working together to eliminate waste, and hence reduce costs, partners can avoid duplication of quality checks and planning processes, misunderstandings and abortive work, claims and legal disputes as well as payment delays. By achieving these efficiencies the partnering approach will allow the parties to minimise total costs, reduce lead times and deliver better value for money.

A partnering approach has particular attractions for MoD and its suppliers, as many requirements are surrounded by uncertainty, involve complex, high value, high risk work, and require a constant search for innovation and continuing cost improvement. Competition is normally used to choose a partner and to provide reassurance at intervals thereafter that MoD is continuing to achieve value for money.

8.11.6 Innovative proposals and innovative bids

It is important that innovative approaches are encouraged so that they provide the fullest potential for improving value for money. Innovative (or unsolicited) proposals may lack much of the detail necessary to undertake a normal assessment. Lack of detail must not preclude fair consideration of an idea. The key point is whether the idea has the potential to deliver MoD better value for money.

8.11.7 Risk allocation

In any PFI project the degree of risk transfer will depend on the nature of the project. The aim is to achieve the optimal and most sensible allocation of risk between MoD and the supplier, so that risks are placed where they can be managed and controlled most cost effectively. This is fundamental to PFI. The schematic diagram in Figure 88 shows that as risk transfer is increased beyond the optimum, there is a reduction in value for money. This is due to the premium that suppliers charge for managing those risks that they are less well equipped to handle.

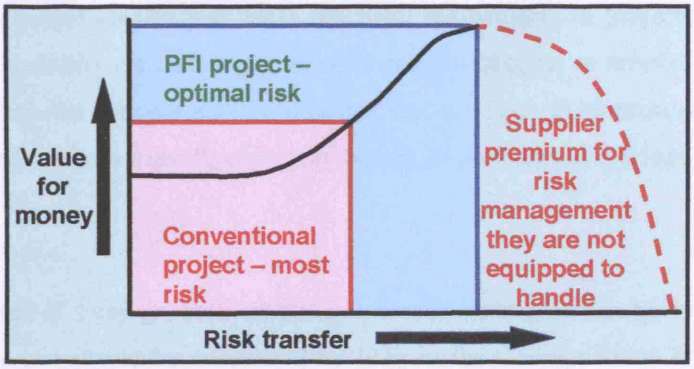

Figure 88 Comparison of risk transfer and value for money in conventional and PFI projects.[242]

The main claimed benefit of risk transfer is that it generates the incentive for the supplier to deliver cost-effective and higher-quality services on time. As a general rule, MoD should seek to transfer those risks where the supplier can influence the outcome. It is interesting to note that residual value risk concerns the value of an asset or equipment at the end of a contract, which may or may not be fully realisable.

8.11.8 Industrial implications

DPA has established procedures for considering industrial factors, and particularly for consulting with the DTI whenever a project may have implications for the UK defence industrial base. These arrangements should, at least in principle, operate for all PFI projects.

8.11.9 Factors to consider [243]

MoD will wish to specify a project duration that is expected to result in the best value for money solution. Factors to be taken into account when deciding on the duration of the contract will include:

- The service requirements of MoD.
- Possible alternative uses of assets for MoD, which might result in significant residual value.
- The affordability of the service for MoD, taking into account the expected useful economic life of the underlying assets.
- The need for and timing of major-refurbishment or asset-refreshment programmes.
- The possibility of an option to extend the contract term by entering into a further contract period with the initial contractor even if there is no alternative use.

Some assets (e.g. vehicles or property) may have an alternative use, which means that they can generate revenue for the contractor after the contract expires. In such circumstances, the contractor may not expect to recover the full cost of financing its investment over the life of the contract. Rather it will be able to recover the balance by putting the assets to alternative use at the end of the contract. The price the contractor charges MoD can therefore be lower and the contract duration shorter than would be the case if the contractor needed to recover all its costs over the life of the contract.

Given the rapid pace both of technological change and MoD functions (particularly in projects involving IT), MoD should ensure that contracts are sufficiently flexible to allow changes to services over time. If, however, MoD is concerned that changes will be so radical that a service in its present form may become redundant it may wish to retain some flexibility by having shorter contract periods, consistent with affordable financing plans.

8.11.10 Comment on PPP and PFI

PFI and Partnering Arrangements are part of a key government policy aimed at getting better quality equipment and services at optimal cost and should be considered by IPTs in the Concept Phase of projects. The aim of the approach is to deliver significant performance improvements and efficiency

savings. PFI should smooth out and reduce the peaks in project expenditure. It is also claimed that it will provide better allocation of risk, improved incentives for the contractor to perform and make the best use of skills. Part of the aim is to achieve the optimal and most sensible allocation of risk between MoD and its suppliers. There are still questions about how far industry is likely to be prepared to invest in such projects and how PFI projects using civilians will function in war. Finally, although PFI reduces capital investment it also increases future-revenue expenditure.

8.12 Study days and meetings

The results of two study days and two meeting are described below. A further study day and three meetings with MoD, one with NAO and three with commercial organisations all provided useful background information on value for money but no pertinent facts.

8.12.1 DPMT Tender Assessment and Contractor Selection (TACS) one-day course – 9 Jun 03

Some dozen IPT and potential IPT members attended the course. The course tutor was an elderly commercial officer who seemed very inflexible but who presented well and included plenty of appropriate anecdotes from real-life experience. The course had no programme timetable. In the afternoon, there was an excellent group-practical session trying to evaluate a case study set of 7 tenders. Unfortunately, there was no hard copy of the slides used but a few useful handouts. The day ended with a presentation on SIBET, details of which can be found in Section 5.3.4.

The TACS process begins with the requirement and requirements capture as expressed in the URD. The process then moves to the SRD, the ITT, responses from bidders, the tender assessment, a contract with the chosen supplier and project acceptance leading to an ISD.

TACS involves identifying which compliant bid offers best value for money and is undertaken to provide an auditable trail. I queried the inclusion of the word 'compliant' but was told that non-compliant bids could not be considered. After contract award, the bidders are then debriefed.

1 Pre-ITT

MoD must comply with legal requirements; these include such factors as the EC procurement directive and security measures. ITTs must normally be advertised in the MoD and EC bulletins 70 days before release. Pre-ITT tender selection should examine the following:

Design rights holder Last winner Near misses	Quality approved list PQQ list	New suppliers Recommendations

The IPTL and the senior commercial officer approve the final list.

The methodology and tools needed are a marking scheme, assessment criteria and the potential use of Multi-Attribute Choice Elucidation (MACE)/DOORS/AWARD/others programs and SIBET. The relative weightings are agreed at the beginning with project team. The ITT must include:

Instructions to tenderers	Terms & conditions
DEFCON 47	Details of compliance & environmental legislation
Schedule of requirements	Required delivery programme
Specification	Details of anything that is government furnished
Compliance matrix with evidence of extent of compliance	Type of price to be quoted
	Optionally details of the budget

The ITT must ask for the following information:

Completed DEFCON 47	Reliability & maintainability plan
ILS plan	Health & safety plan
Quality plan	Delivery schedule
Risk analysis & risk management plan	Environmental plan

2 *Methodology and tools*

There is a need to use qualitative tools to avoid subjective assessments, with MACE the preferred route. However, its use is not mandatory. Sources include DOORS and AWARD, described in Section 5.3. The methodology has been specifically developed for MoD as an aid for assessing tenders. It addresses both technical and commercial issues. It takes key issues from URD/SRD and turns them into criteria the value of which can be determined numerically via a step-by-step process. It results in a hierarchical structure of clearly defined and measurable items known as tip criteria (See Figure 89).

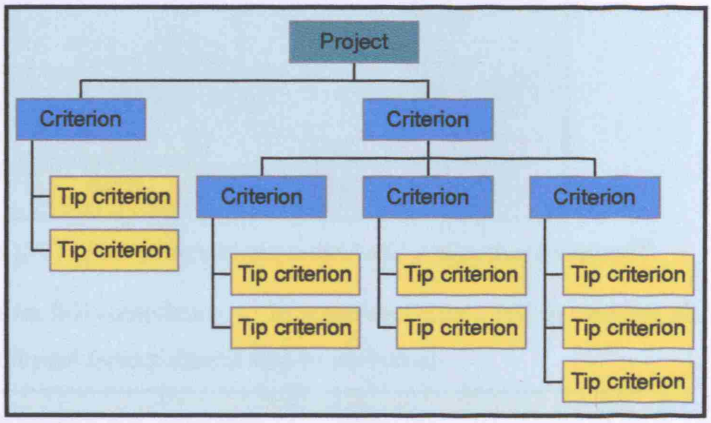

Figure 89 A simple hierarchical structure showing tip criteria.

Weighting factors that reflect the relative import of all criteria belonging to same parent are given to all but the top-level criteria. Values are assigned from 1 -100, then normalised (if 3 values are 100, 50 and 25 – total 175, then divide each figure by 175 to give normalised ratios of 0.57, 0.29 and 0.14). Calculations should be made to show:

F = achieving what is in the specification. O = optimistic result.

L = likely result. P = pessimistic result.

3 *Pre-contract award evaluation (PCAE)*

Internal issues at the start of the tender-assessment phase include who will get copies of tenders and whether they are priced or unpriced. Surprisingly, the main external issue is whether the award criteria should be issued at the ITT stage. The process of assessing tenders takes place against an agreed

marking scheme issued with ITT. A defensible recommendation is needed for the bid offering best long-term value for money that meets the defined requirements. It is important to assess the capacity of the contractor to fulfil a contract prior to award. There should be an objective comparison of technical, commercial and managerial factors. Risks must be identified, particularly for any company unknown to MoD or moving into a new field. Factors to be considered during PCAE include:

Resources	Security clearance	Fraud	Visits
Funding	Confidentiality	Reports	Travel
Planning	Escalation of issues	Meetings	Forms

PCAE consists of eight stages; these are shown in some detail in Figure 90 below.

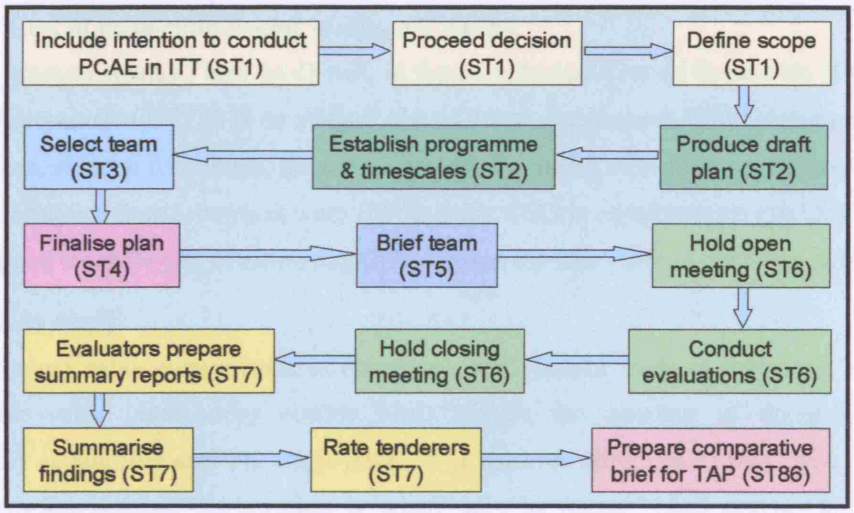

Figure 90 A summary of the stages (ST) of the pre-contract award and evaluation process.[244]

Reasons for an evaluation are to confirm full compliance, to increase confidence and to evaluate all high-lighted risks. All the following additional factors should also be evaluated:

Technical capability	Estimating/cost recording	Personnel
Contract documentation	Manufacturing processes	Records/filing systems both electronic and manual
Financial capability	Facilities	
Quality procedures	Design capability	

The evaluation should first establish a baseline, and then use sampling, questionnaires and demonstrations. Evidence is needed and a decision must be made on the reporting method to be used.

When recording findings, it is vital to be objective, concise and comprehensive. The findings should be written so as to permit third-party conclusions and should include observations and an evaluation of the findings. The document must include any evidence and summary report given to each bidder.

4 Contract negotiations and award

Post-tender negotiation should help to improve the value for money of the bid by the top contender whether dealing with PFI, a preferred bidder or sole source supplier. There needs to be a consensus on

the compliant bid offering best long-term value for money by using the results of tender assessment and taking into account the PCAE, post-tender negotiations and any political issues. The assessment team together with the IPTL select the contractor and the commercial officer signs the contract.

5 Conclusions

Attendance on this course was particularly beneficial in showing the tender-assessment topics taught to IPT members and in outlining the process employed. The major surprise was that non-compliant bids must be rejected regardless of the value for money they might offer. The course also confirmed that neither the use of MACE nor of SIBET is mandated. While political issues were mentioned once, there was no mention of the majority of the 'wider factors' detailed in Section 8.1.1.

8.12.2 DLO Cost of ownership Senior Manager's course

This one-day course explained how MoD will, in future, calculate Cost of Ownership (COO) and its impact on decision-making. COO is an integral part of Smart Acquisition. While dealing largely with the 'money' side of value for money, the course provided a useful view of the problems IPT leaders face in source selection (most attendees were IPT leaders). COO is complementary to COEIAs and the course highlighted the difficulty of estimating COO beyond the four years of the Short-term plan.

8.12.3 D (S&A) Air [245]

Within MoD, some value measurement is objective using models; some is subjective and some is random. Wider value implications outside MoD include the question of domestic purchase, maintaining key capabilities and UK employment. It is apparent within MoD that these implications have to be taken into account, but less clear is 'what?' and 'by whom?' MoD also has to consider the net effect on the Exchequer of export royalties. Political factors must be shown but not taken into account. DPA is seen as risk averse and 'financial target' rather than 'value for money' driven.

8.12.4 An IPT leader

This IPTL, seconded from industry, is running a single-source contract using a Public Sector Comparator (PSC). The PSC includes only the salaries, not staff-training costs or the command hierarchy (overhead). For industry, the price covers everything based on employees working 1500/1600 hours/year. Is there a cost/employee for DLO? The contract has performance indicators with liquidated damages, as well as trend indicators; mainly financial. With a transactional contract, the more business that is done, the more profit for the contractor. The right incentivisation is important. MoD looks at the cost of every item, not the whole-programme cost. It could set output-based contracts. MoD thinks half of incentivised contracts will fail to deliver, so why do they place such contracts? MoD draws artificial boundaries. On this support project, there are only three factors:

- Labour – all training is done by MoD with manuals from the IPTL's company.
- Specific items are provided by the IPTL's company.
- Non-specific items are provided to MoD by other companies.

All three factors affect availability but leave open for industry whether the maintenance is well done, done at all, or whether the equipment is abused. There are also queries about failure reporting. All can reduce availability and increase cost.

He thinks that in MoD, best value for money equals lowest cost. Industry does not get involved with trade-offs of performance against time. He feels that unsolicited bids are not worth submitting. He feels that joint-MoD partnerships would make business more efficient. He believes that holding competitions is important, but the competitive process is often considered too hard to manage and too time consuming. In MoD, he thinks that the status quo is the default that may not be the correct way to proceed. By signing long-term partnerships, industry has better foresight and can make the necessary investments. Defence is a long-term business. The same problems feed down to sub-contractors.

Often, MoD doesn't know exactly what it wants and whether it is affordable, and should work closely with a company that has the capability. MoD understands quantities of items rather than costs. They might ask for a specific number of equipment changes per year rather than providing usage data.

A lack of new 'platform' programmes provides balancing opportunities for update programmes, as whole-life costs are typically ten times the initial procurement cost. Stovepiping is a service culture issue where the cost and benefits lie in different places.

8.13 Conclusions

1. MoD's choice of best value for money solution also depends on political imperatives, which are not considered in source-selection analysis. Changing MoD's recommended supplier for political reasons may reduce value for money.
2. Best value for money may not be achieved if there is automatic rejection of any offer except the cheapest compliant solution, offers with any non-compliances or those that exceed stated user needs without a reassessment of the original capability requirement.
3. Neither a demand for too great a capability nor the allocation of too small a project budget offers best value for money, and value varies with time and changes of circumstance.
4. PFI aims to improve the value for money MoD obtains at the expense of increased future revenue expenditure. It is questionable whether this will provide long-term value for money.
5. MoD's concentration on achieving the required performance and its inability to avoid timescale and cost overruns indicates a degree of bias in the acquisition of major projects.
6. The factors that must be taken into consideration when appraising bids are numerous and even so some factors appear to be missed in MoD evaluations.
7. Defence acquisitions involve many stakeholders, including some outside MoD. Their departmental and individual considerations will impact on MoD's evaluation of value.
8. Stovepiping is an issue since benefits lie with each IPT while cost impacts on MoD as a whole.

9 MEASURING VALUE FOR MONEY

In examining how to measure value for money, the main issues can be sub-divided into four main areas: which parameters are of value, how buyers assess value for money, how suppliers prove the value of their offerings and partnerships. These are all important considerations when seeking best value for money. Each parameter then further sub-divides into a wide range of factors that are illustrated in Figure 91 and have already been examined in detail.

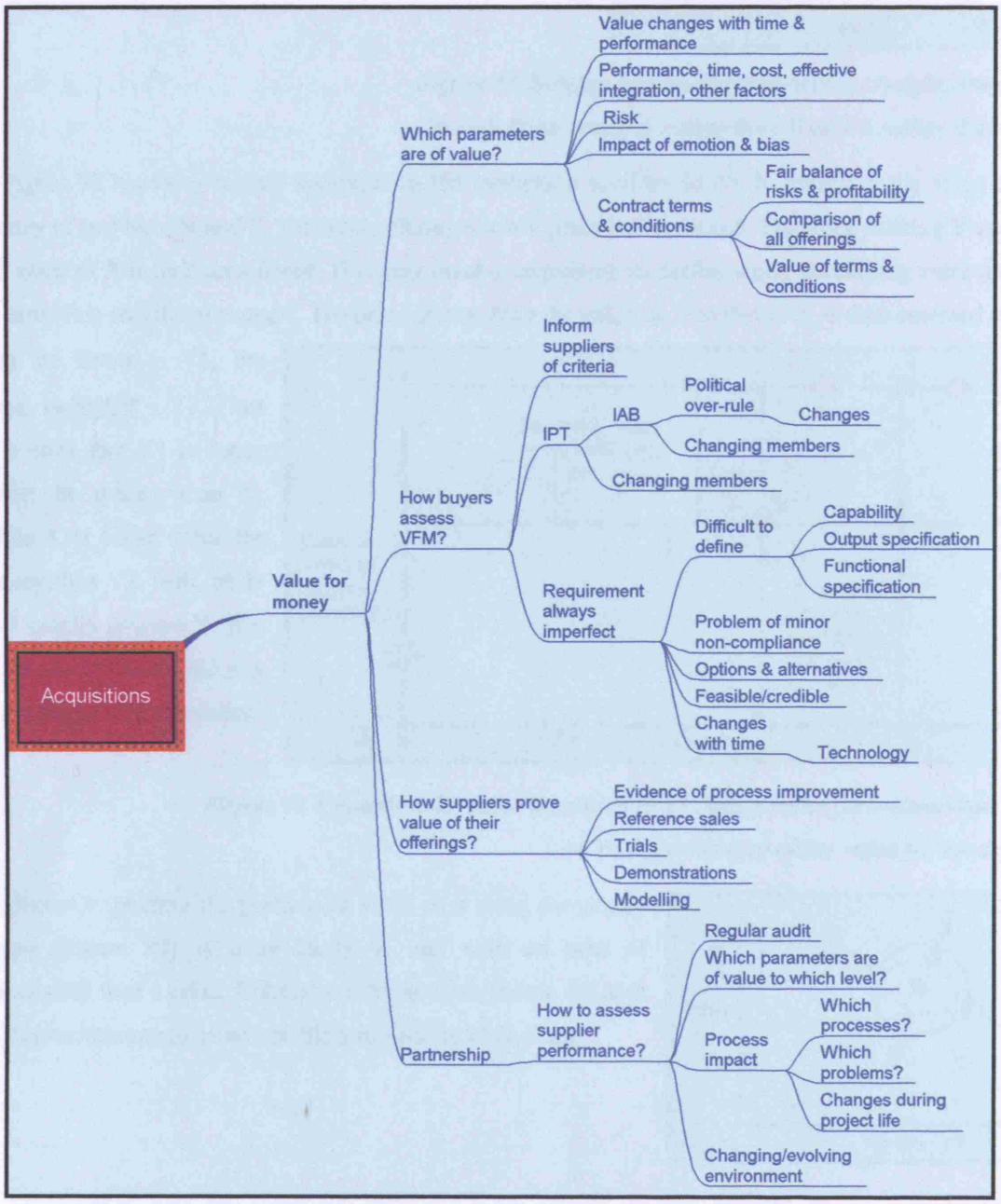

Figure 91 Successful acquisition depends on selecting the best value for money solution that is affordable. This involves assessing a wide range of factors.

It is straightforward to compare the value for money of offers giving identical value with varying prices or giving different value with identical prices and this is shown in Figure 92. A is better value for money than B; X is better value for money than Y. The problem occurs when both value scores and prices differ, as they normally do in any meaningful competitive acquisition.

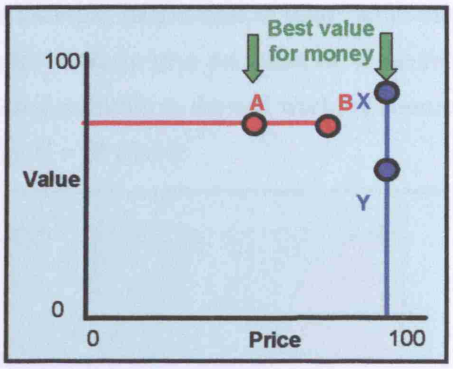

Figure 92 Judging best value for money is straightforward in both these cases; A rather than B and X rather than Y.

Figure 93 shows a current approach to bid evaluation used by MoD. It compares the value for money of two bids, X and Y, the latter offering a lower price but less value. The price to bring Y up to the value of X is then considered. This may involve improving its performance, purchasing extra units or providing additional support. The price of matching the value of Y to that of X is then assessed and may be lower – Y1, the same, or higher – Y2. Thus it is clear that Y1 is better value for money than X, while X is better value for money than Y2. Still, MoD will usually procure Y, if it is the lowest-priced bid that gives the needed capability.

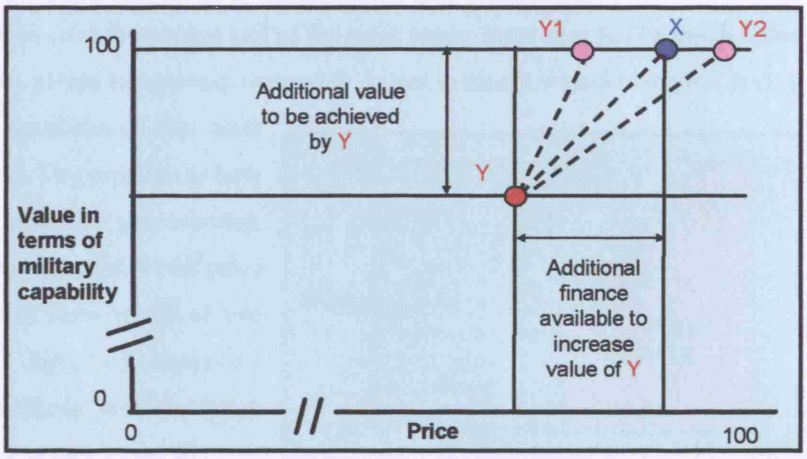

Figure 93 Y can have its value increased to Y1 (better value for money than X) or Y2 (representing worse value for money).

However, plotting the position of a bid on a value for money graph (Figure 94) is more likely to end with an area of uncertainty than a point. Efforts must be made to reduce the area of this uncertainty to an acceptable scale before Main Gate.

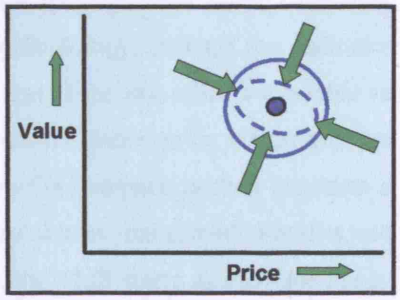

Figure 94 Any solution is likely to provide a band of value, probably for a range of prices. Squeezing the size of the area of uncertainty is an essential part of bid evaluation.

A key question is how to relate value to price. It would, for example, be possible to score value out of 100, score price out of 100, and divide value score by price score to give an index of value for money. However, such a linear relationship is unrealistic and thus unusable in the real world of source selection. The connection between value and price is defined by **V = fP** where:

V = value. **P** = price. **f** = a function linking **V** to **P**.

In the real world, function **f** is extremely unlikely ever to be linear, as shown in Figure 95. Initially, too low a price either gives zero value or insufficient value to the acquirer. The blue value-against-price curve represents a set of possible solutions yielding different levels of value.

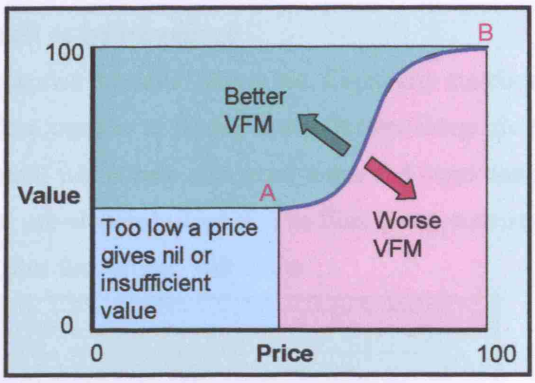

Figure 95 In V = fP, f is almost invariably not a linear value, as is shown by curve AB.

The curve starts with a shallow slope then grows steeper and finally flattens again for the last part of value. This is a likely situation since at the bottom end of the price range, there may not be much value while at the top end extra value seems excessively expensive. It ties in nicely with the age-old saying that it is the last 10% of the specification that costs most money (in this case 25%). The problem is how to define the term '**f**' for any particular procurement. If it could be defined, then two bids of different price and value might be compared to show which of two offers, X and Y, each with a degree of uncertainty represented by the size of the ellipse, provides better value for money. It is, however, a very large 'if'.

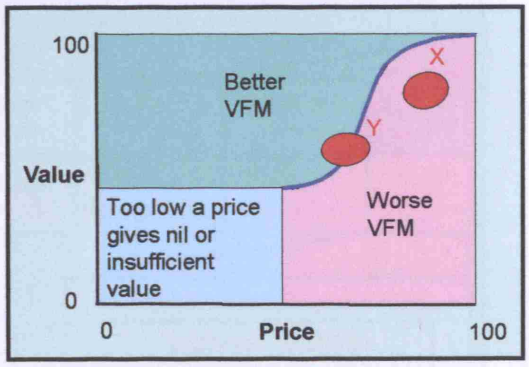

Figure 96 In this case, Y offers better value for money than X.

In the case of capability requirements, comparison of individual qualities may prove extremely difficult, making it hard to compare value by any conventional methodology. Perhaps this indicates that, for equipment that is not OTS, MoD should, based on their experience and what is available in the marketplace and having defined the capability they need, make a decision on which type of solution is preferred, allowing MoD to issue a specification. Benefits comparison then becomes a somewhat more straightforward task. However, there are many other factors that provide benefits and including them increases the difficulties significantly. Furthermore, the AMS warns against '*the use of mathematical models to attempt to weave the wider factors into the COEIA ... as it could mislead the IAB and ministers into thinking that all factors have received adequate consideration.*' It is understandable why the use of mathematical models to attempt to weave the wider factors into

COEIAs is not a good idea. However, it would surely help the IAB and ministers to assess all factors in Business Cases if mathematical models were used to assess separately these wider factors, although it would be difficult to place weights on them. There appears to be no valid answer to this point in any of the mass of MoD documentation that has been examined during this research.

9.1 Categorising the value parameters that need to be measured

Figure 97 shows the five groups of parameters that comprise the value of any bid. Capability matches the Smart Acquisition term 'better', while delivery time equates to 'faster' and effective integration has recently (2004) been added. 'Other factors' are listed, while the commercial terms and conditions that are likely in the contract with the winning supplier are obviously crucial. The final group consists of the risks for each of the parameters already quoted, plus the various 'soft issues'.

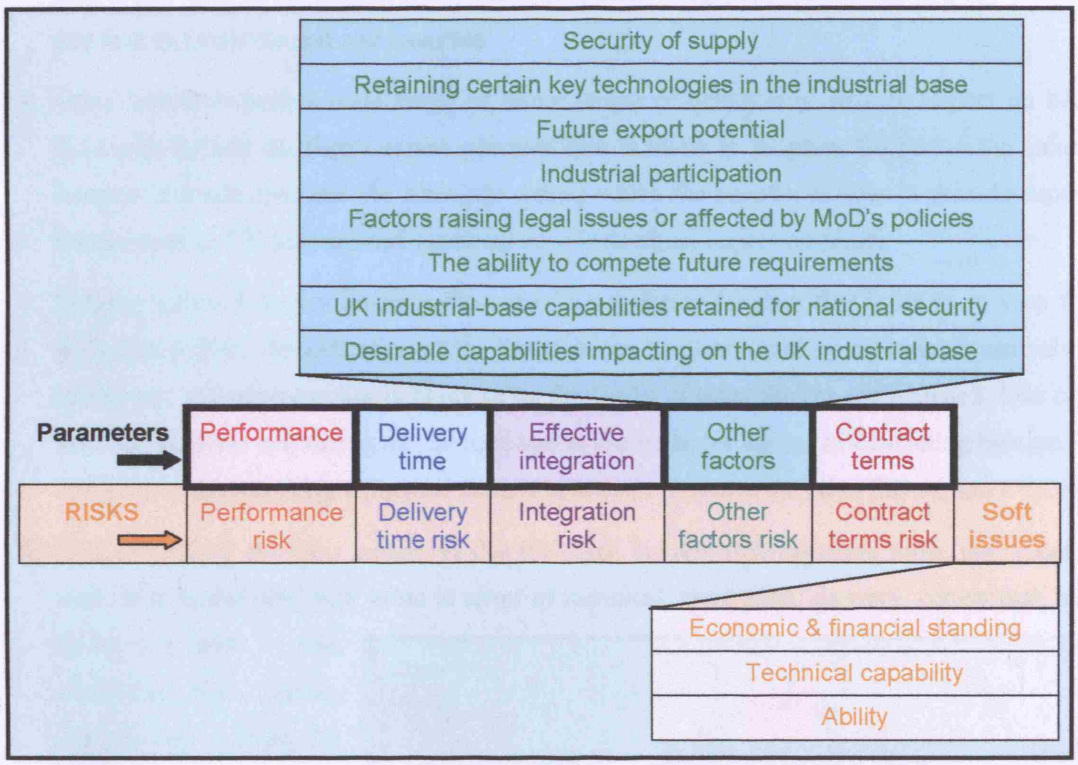

Figure 97 The various parameters that need to be measured to assess the value of each bid.

9.2 Uncertainty in measuring best value for money

There are a few problems of uncertainty in deciding which of several bids offers best value for money:

1. There is substantial uncertainty about how well proposed new and complex equipment will perform and what capability it will provide once in service. Historically, when two solutions were both chosen to meet a given requirement, the actual performance of one solution was often far better than the other. The record of two aircraft illustrates the point, despite the fact that both aircraft were built to meet the same requirement by two companies, both with fine track records.

The Hawker Hunter [iii] was a great success [246] while the Supermarine Swift was a dramatic failure.[247] However, only in battle will the true performance and value of equipment emerge.

2. Delivery timescale is a contractor promise that historically has often been missed. In 2000, NAO [248] reported that the ISD of 17 out of 20 major projects had slipped since Main Gate; an average of 28 months per project, often with more to come before actual delivery. Thus, in accessing delivery, there is a clear risk of slippage. It is noteworthy that delivery slippage and cost over-runs seem to be more acceptable than failure to meet performance criteria (which according to NAO Major Project Reports rarely occurs).[249]

3. Effectively integration is a difficult to measure and is dependant on the equipment type. It is particularly hard in the case of C^3I systems. It is often integration and interoperability problems that lead to timescale and cost overruns.

4. Other factors include a wide range of issues, some of which may directly impact on MoD. Examples include the future export potential that is likely to lengthen the period the solution remains in production and the timescale during which the supplier is able to provide support. Others, such as UK jobs created/sustained have little direct impact on MoD.

5. Relating value to money involves the use of a non-linear function that is likely to vary from project to project. An indication of the function can be determined by operational analysis for operational effectiveness but is likely to be far harder if other factors are included. Use of an incorrect function will distort any comparison of the value for money of competing bids and the AMS warns against using numerical models to attempt to weave the other factors into a COEIA.

6. With two offers, one more expensive that the other, but also offering more value, the procedure must be to isolate the extra value in terms of technical, integration, delivery, contractual, other factors and risk (including soft issues), and then to evaluate the variations to find the better solution. This is shown in Figure 98 where some areas of Bid A are superior and in others less attractive than for Bid B.

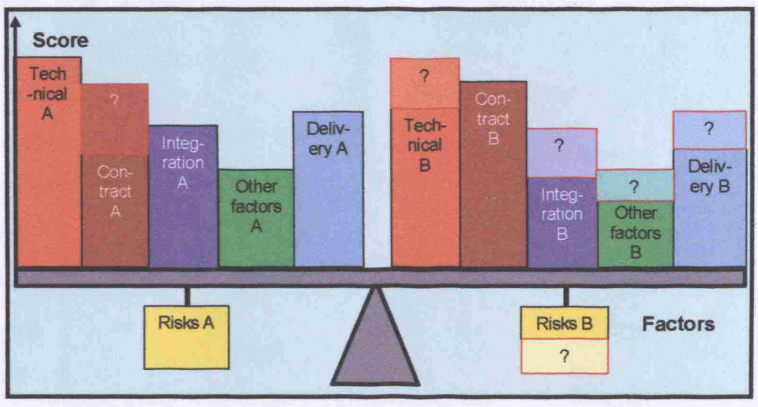

Figure 98 Differences in technical solution, integration, delivery, contract terms and other factors can be shown and need to be evaluated for any pair of bids.

[iii] *'1,972 Hunters were manufactured ... to serve with 18 different countries.' 'The Swift was spoiled by serious handling and engine problems... Total production 167.'*

7. These various differences, which represent the difference in value between the two bids, must be then balanced against the difference in price between them. In comparing the bids some of the differences will be positive and some negative. This is shown in Figure 99.

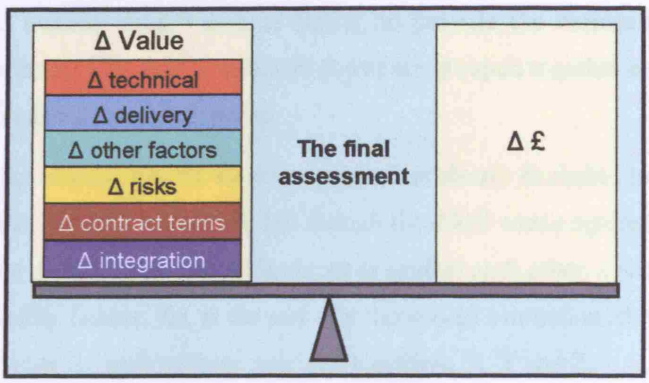

Figure 99 Balancing the differences in value (Δ V) against the difference in investment (Δ £).

9.2.1 Issues in deciding value for money (VFM)

Figure 100 shows six groups of issues under the heading value, and a seventh – money that need to be assessed when examining the value for money of competing bids. These are:

1. Technical capability provided.
2. Delivery timescale – The 'In-service date' is declared when the military capability provided by the system is assessed as available for operational use.
3. Effective integration.
4. Other factors which MoD consider.
5. Contract terms and conditions.
6. All the risks to the programme.
7. Money – This parameter, whether initial or through life cost, includes factors such as cash profile, affordability, net present value of discounted cash flow and resource cost; it may also include exchange-rate variations and future inflation, but it is not considered further in this thesis.

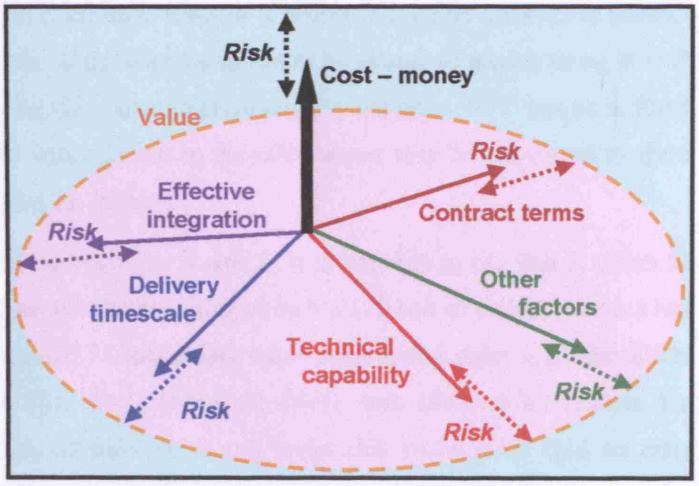

Figure 100 The various factors that combine to make up value; each with its separate degree of risk. The total value can then be compared to the price – money.

Each of the value and cost factors also include risks,[iii] such as failing to provide the required capability, of delivering late or of price escalation. The first five factors above are grouped together as representing value and their risks can be added to form a sixth group.

Assuming that the money part of 'value for money' can be measured, then it is clearly desirable to measure the relative totals of the value factors for each competing bid though the AMS warns against this practice. The difficulties are extreme in trying to weigh the different areas against each other; even more so than trying to weigh different capability factors. So, at the end of a theoretical evaluation, the following table shows imaginary scores on value for each of three potential suppliers, X, Y and Z.

	Factor	Weight	Supplier X	Supplier X score	Supplier Y	Supplier Y score	Supplier Z	Supplier Z score
OE	Performance	10	80	800	72	720	85	850
	Timescale	8	92	736	84	672	77	616
	Integration	9	75	675	71	639	76	684
BC	Other factors	1	50	50	55	55	45	45
	Contract terms	2	50	100	44	88	47	94
	Risks	5	88	440	81	405	83	415
	Value			**2801**		**2579**		**2694**
	£M		109		113		92	
	Value for money			Higher value, higher £ than Z		Worse than X & Z. **Discard**		Lower value, lower £ than X

In the example above, both price and value are different for each competing bid. The present evaluation system involves increasing the value (at additional cost) of each bid up to the value of the best value bid and then comparing prices. This exercise may include, for example, purchasing extra units or providing additional support. The question is whether it is always actually possible in practice to increase the value to equalize the prices. If not then value has to be related to money using **V = fP** where: **V** = the value, **f** = a function connecting value to price and **P** = the price. If '**f**' can be defined, then the two bids of different price and value shown in the table above may be compared to show whether offers X or Z provides better value for money.

Alternatively, considering the two short-listed bids, X and Z, it is possible to say that Z offers 50 more value points of capability and 9 more of effective integration but 120 less of delivery time, 5 less of other factors, 6 less of contract issues and 25 less points when considering risks. Z is also £17M cheaper. The question that then follows is: Are a lower capability, less effective integration, but shorter delivery and better other factors, contract terms and lower risk worth more than an extra £17M? If they are, then X is best value for money. If not, then Z is best value for money. At least this method of looking at the cost of the differences reduces the number of individual factors to be considered. Since capability, effective integration and delivery are combined in a COEIA, use of a

[iii] Risk may also be positive – early delivery, lower cost or better performance.

similar approach to the factors in the Business Case, other factors, contract terms and risk, would be attractive. In the example above, offer Z then gives 79 less points of operational effectiveness and 36 less to the Business Case factors but is £17M cheaper.

Figure 101 shows in graphical detail how bid assessment could be undertaken. The COEIA will look at capability, effective integration and delivery. Contract terms and other factors could be included in a Business Case scored evaluation, together with the various risk factors (the items below the 'total value score' in the diagram).

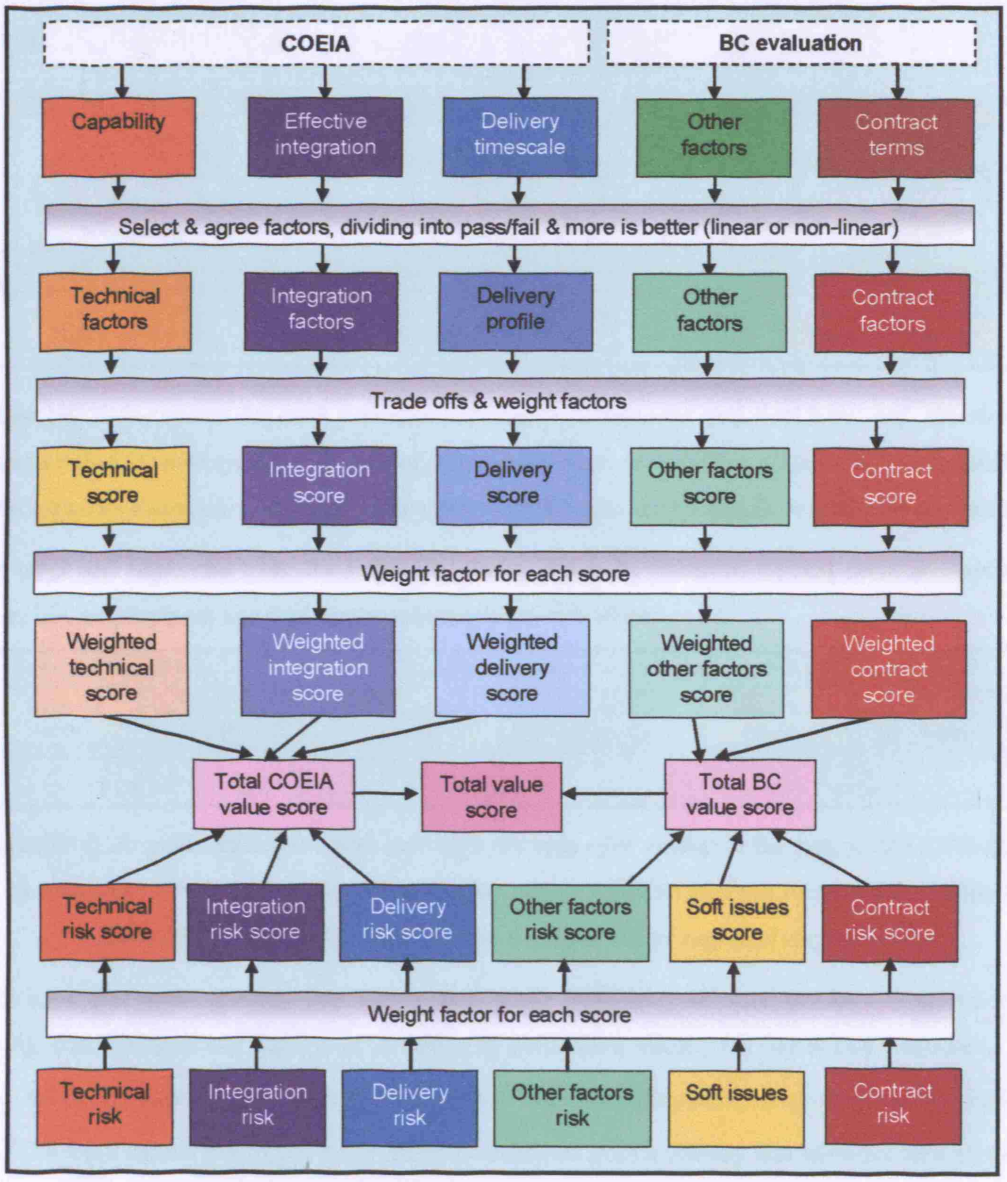

Figure 101 A way to evaluate the non-financial (value) part of each supplier's bid.

Figure 102 overleaf indicates how the total value scores for three competing bids are compared and, together with the total price and price risk, give a value for money for each bid.

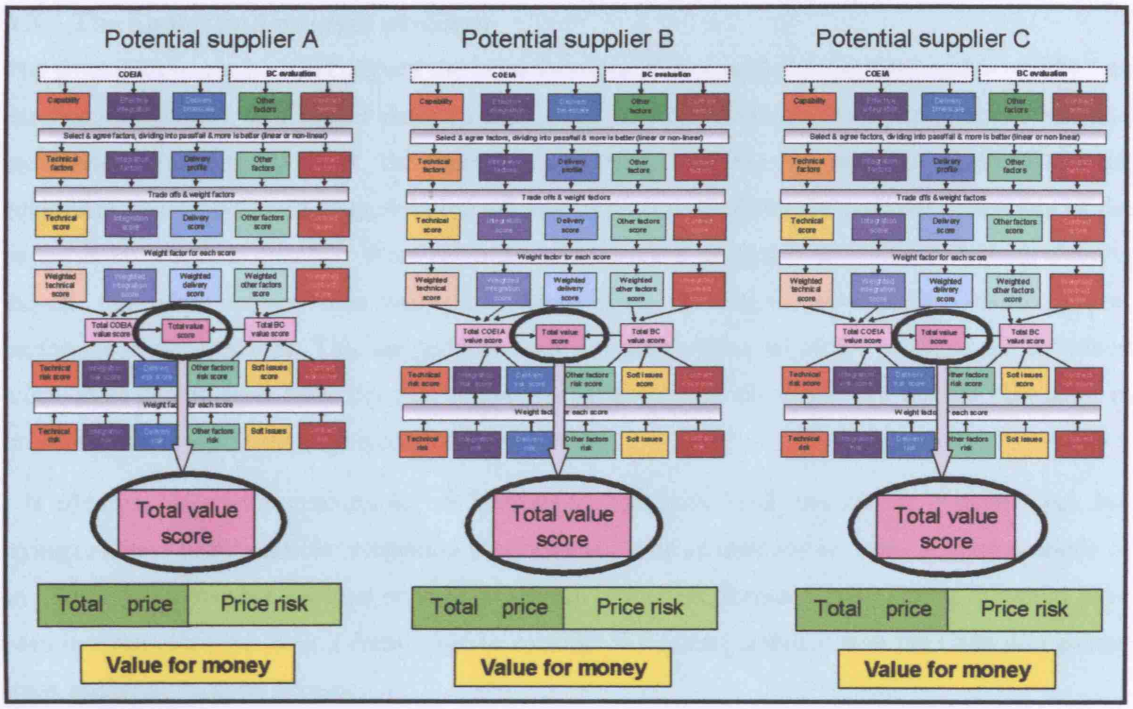

Figure 102 Value scores for each potential supplier are compared and then balanced with the price to give a value for money score. If several scores are equal, then if they all provide the capability in the required timescale with acceptable degree of risk, the cheapest solution should be chosen.

For large and important bids, the value for money has to be balanced against political imperatives such as UK employment and diplomatic relationships with allies.

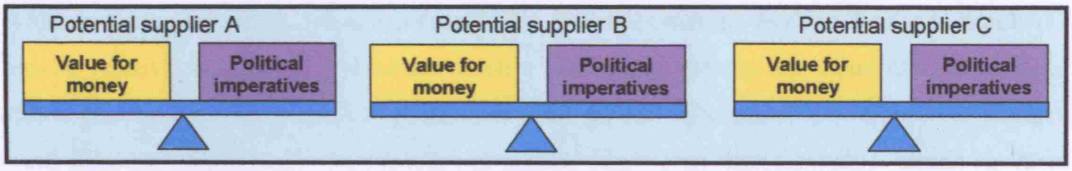

Figure 103 If the political imperatives outweigh the value for money in the eyes of the Cabinet, then the supplier offering MoD the best value for money solution may not be selected. Political imperatives are usually based on the need for UK or regional employment.

The issue that arises from Figure 103 is that, while MoD may selected the best value for money offering, their decision can easily be overridden by politicians, usually for one of three reasons:

1. A UK contractor, usually based in a region of high unemployment, must carry out the work.
2. The work cannot politically be given to a contractor from a country that does not support the UK political stance, for example in the United Nations.
3. The Treasury considers that the solution that has been selected is too expensive.

A problem for any multi-criteria decision analysis, such as DOORS and AWARD used by MoD, is that the analysis applied by the IPT and reviewed by the IAB, does not include political weighting.

9.3 The apples and oranges problem

The great dilemma is how to compare the main variables. For example, it may be possible to calculate the financial impact of a longer delivery time, such as the increased maintenance cost of old and unreliable equipment. However, the impact of deploying obsolete equipment in a war where the equipment is destroyed and its crew killed because of its poor performance compared with that of the enemy is far harder to quantify. What is particularly interesting is that NAO's Major Projects Reports indicate that while delivery time delays are commonplace, there is virtually never a failure to meet performance requirements. This suggests that for the stakeholders in MoD, performance is valued much more highly than ISD. Equally, it may mean that timescale delays are almost inevitable in implementing complex major projects.

Is effective integration measurable? At a relatively simplistic level, the answer is clearly yes, but trying to assess every possible integration issue appears to be an unattainable task. A good example of an unexpected issue is combined operations with troops of the former Soviet Union. It would have been inconceivable just over a decade ago to consider IFF interoperability with the Cold War enemy when procuring weapon systems.

The Department for Transport, Local Government and the Regions multi-criteria analysis manual [250] states that whilst it isn't possible to combine money, ticks, stars and ratings to achieve an overall evaluation of equipment, MCDA [kkk] shows how this may be done by constructing scales representing preferences for the consequences, weighting the scales for their relative importance, and then calculating weighted averages across the preference scales.

What do these preference scores represent? The difference-scaling method results in numbers that represent relative strength of preference. Such a measure expresses the value associated with the option's consequence on a particular criterion. The phrase 'strength of preference' is being used instead of 'value', because the latter is often thought to imply only financial value. However, 'strength of preference' should not be confused with 'preference.' In decision theory coherent preference logically implies two measurable quantities, probabilities and utilities. Strictly speaking, utility is a measure of both subjectively judged value and the assessor's attitude toward risk. Utilities are properly assessed using hypothetical wagers, which invoke the assessor's risk propensities. Because the direct scaling method used here does not involve wagers, the resulting numbers are measures only of value.

The MoD does not recommend combining wider factors into the COEIA but requires that they should be highlighted in the Business Case. Perhaps integrating all the wider factors in the Business Case and presenting them together with the COEIA would ensure that they receive adequate consideration.

[kkk] MCDA is discussed in Sections 5.1.12 and 5.4.

It is the role of actuaries is to express risks in financial terms. This means that it should theoretically be possible to place a financial value on any of the risks shown in Figure 104 for which there is a statistical database. For most major project, such data will not exist as far as technical and integration risks are concerned, due to the unique nature of the majority of such projects. However, for the other risks, there is no reason why an actuarial process should not be used to put a financial cost on them.

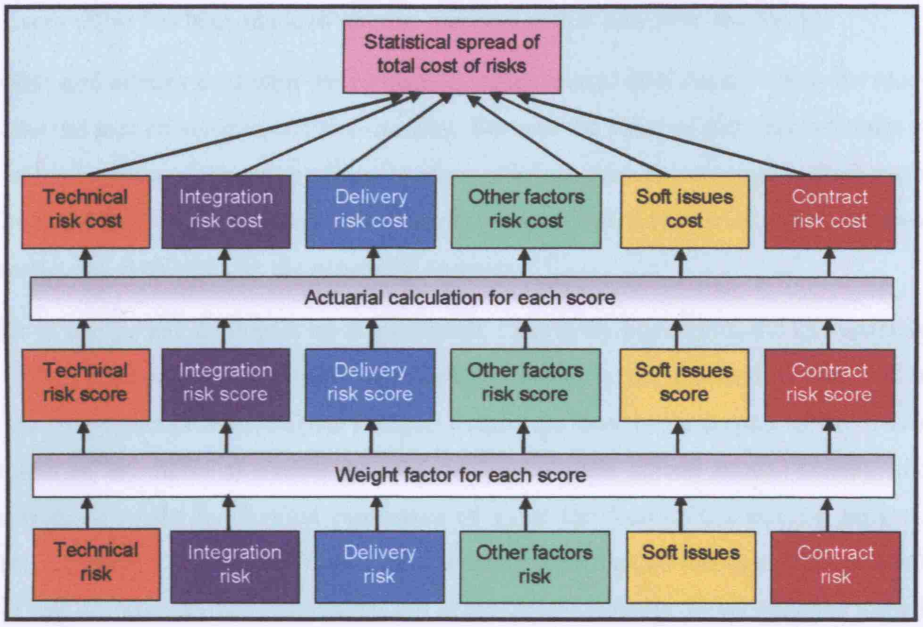

Figure 104 The risks shown in Figure 101 could potentially be converted into actuarial costs if sufficient statistical data is available.

9.4 Conclusions on measuring value for money

1. Relating value to money involves a non-linear function that is project dependant. Use of an incorrect function will distort any comparison of the value for money of competing bids.
2. It would help decision makers if mathematical models were used to assess separately the wider factors found in Business Cases.
3. Timescale slips and cost over-runs appear to be more tolerable than inability to meet performance parameters.
4. Effectively integration is hard to measure and often problems with it lead to timescale and cost overruns.
5. While MoD selects best value for money offerings, for major bids the value for money has to be balanced against political imperatives.
6. For any risks where there is a statistical database, an actuarial process could put a financial cost on those risks.

10 CONCLUSIONS

The research carried out has included seeking a wide range of documentary evidence, examining value models, algorithms and software including those used by MoD, setting a topic for an MSc dissertation and supervising the work carried out. The information gathered on how MoD and other organisations define value and the methods they use to obtain best value for money formed a cornerstone of the research. Every effort has been made to remove personal author bias from the results.

Many books and articles deal with the subject of value; several also discuss value for money. Some sources cover the uses of value in decision-making. Because the value of different offerings is relative, an unbiased comparison of the value of two or more offerings does not require absolute measurement. It should be noted that value depends on its context, changes with time, varies within different parts of an organisation and is affected by the actions of enemies.

A number of factors had an impact on this research. First is the importance the Government gives to obtaining value for money in all that it purchases. Second is the demand on the UK and other industrial nations to reduce their defence budgets despite the need to participate in the 'war on terror' and regardless of the effect of increasing weapon-system costs in real terms. Thirdly, the COEIA process provides a useful but limited evaluation of value for money; it considers only operational effectiveness as value. The Business Case includes many other factors that also form part of the value equation. It was unfortunate that towards the end of this research (early 2004) effective integration was added to the Smart Acquisition epithet of 'Faster, Cheaper, Better.' Although the change has been reflected in this thesis, it has yet to find its way into many aspects of MoD acquisition.

10.1 Present situation in MoD

Multiple Criteria Decision Analysis (MCDA) and seeking best value for money are at the heart of MoD bid evaluation, though the organisational separation of initial equipment purchase and its through-life support may result in biased selection criteria and militate against best value for money.

MoD uses state-of-the-art MCDA programs but unfortunately their use, and that of SIBET, is not compulsory. MCDA provides a way of examining complex problems, disaggregating them and dealing with multiple criteria to provide a list of bids in order of preference. However, bid assessment excludes many criteria from the operational evaluation only putting written statements about them in the Business Case. As a result, IAB decision quality suffers due to some reliance on intuition because people do not perform as well as computers when integrating many discrete sub-decisions. In fact, MoD insists that no attempt is made to weave the excluded criteria into COEIAs. This may make the weighting task easier but increases the difficulty of establishing the overall order of bids.

Faster, cheaper, better and more effectively integrated are key drivers of Smart Acquisition but it is apparent that many in MoD still equate best value for money with lowest-cost compliant bid. Current

practice often involves splitting equipment manufacture into tranches and is an affordability issue even though it is unlikely to provide best value for money. IPTs have stated that they require operational effectiveness combined with a timely delivery. However, risk and 'other factors' are not given sufficient weight and risk is not seen as a value factor. At present, to plan for risk control at the bid evaluation stage, MoD does not normally propose different contingency levels on prices quoted in competing bids to arrive at a best value for money solution. Nor does it always use SIBET to reduce contractor risks. However, delivery-time delays are commonplace though there is rarely a failure to meet key performance requirements. The planned increase in the number of collaborative programmes will inevitably increase the bureaucratic risk of project timescales being delayed.

Overall acquisition policy is scattered throughout a number of documents, some of which give contradictory advice. Often those involved in the tender process have no clear knowledge of the entire process end-to-end. The contract-award process on large tenders is sometimes flawed since the final political decision-makers are usually not part of the assessment team and it is illegal to introduce new political (or other) criteria post bid submission.

10.2 Recommendations

A number of factors could improve the effectiveness of MoD's efforts to obtain best value for money in its major equipment acquisitions:

1. In view of affordability issues, MoD should seek the most appropriate value for money rather than best value for money.
2. To achieve best value for money in its acquisitions MoD needs to:
   a. Accept that having IAB decisions over-ridden for political reasons may not provide best value for money.
   b. Ensure budgets are correctly set for the capability needed and not otherwise constrained. MoD must beware of accepting low budgetary figures and optimistic suggested timescales for major projects quoted by industry, effectively establishing them as de-facto baselines.
   c. Improve the trade-off between performance, delivery, cost and effective integration.
   d. Not automatically reject any offer:
      i. Except the cheapest compliant solution. (Offers with any non-compliances.[111])
      ii. That exceeds the user's stated needs without a reassessment of the original requirement.
      iii. Alternatives and options outside the scope of the original call for bids advertisement.
   e. When discussing bids with potential suppliers to get best value for money, MoD should seek an increase in the value of what is being offered at the same time as pressing for price reductions.

[111] IPTs are being trained to acquire the lowest cost, fully compliant bid and automatically reject bids with any non-compliances.

3. To improve IAB decision quality, use of the DOORS or AWARD tools should be mandated for all major projects. The tools should also be used to combine all the factors found in Business Cases. The IAB would then deal with only two inputs; the COEIA and the aggregated weight of all the criteria found in the Business Case.
4. 'At lower risk' could beneficially be added to the existing four aims of Smart Acquisition. Risk should be considered as a value factor or calculated as part of the money side of value for money where feasible. Effort in the Assessment Phase should be increased significantly to reduce major projects risks.
5. MoD could help improve the quality of bid assessment if it could:
    a. Quantify the promise of employment, balance of payments and exploitable new technology as benefits to the nation and treat them as economic factors in appraisal calculations.
    b. Take better account of the effect of the rapid pace of technological change and the corresponding increase in user expectations.
    c. State the technologies and industrial capabilities it needs now and will need in the future.
6. A restructuring of the Acquisition Management System (AMS) to avoid giving conflicting advice and to provide a user friendly format would improve the ability of IPT members to understand the overall process.

10.3 Future work

Two areas that warrant further investigations are the down-selection trend (or possible lack of) and the concept of risk as value. The down-selection trend could have clear possibilities in speeding up the acquisition process but in the small sample of IPTs interviewed none undertook such a down selection; however other IPTs may be following this trend. As far as risk is concerned this would be an extension of the existing knowledge provided to acquisition staff to ensure that in the event that risk becomes a contributing factor in a value assessment it can effectively be marked.

A final outcome of this research is intended to be a book dealing with the subject of value, in conjunction with Stephen Willson, co-author of Winning Major Business.[251] The results of the research will form the basis for the part of the book dealing with customer value while Stephen Willson will provide the section on how suppliers create value.

Appendix 1 Questionnaire used in the MSc dissertation described in Section 6

Examining non-monetary value and decision-making in procuring complex defence systems.

Value

What do you define value as? (If more than one option is selected please rank in order 1 being highest)

Timely Provision of Equipment [] Minimised Risk []
Reduced Through Life Costs [] Increased Availability []
Operational Effectiveness [] Minimised Support []
Increased Technical Capability []
Other _____

Tender Assessment

Did you utilise the default MoD toolsets for tender assessment? (MACE/SIBET) Yes [] No []

How did they help / hinder you in the decision making role?

Greatly Helped [] Helped [] Neither [] Hindered [] Greatly Hindered []

If you did not utilise the default MoD toolsets what guidance / process did you implement?____

_____

_____

_____

The MoD/Defence Industry published Codes of Best Practice assist in tender assessments?

Strongly Agree [] Agree [] Neutral [] Disagree [] Strongly Disagree [] Don't Know []

Did you utilise a Pre Qualification Questionnaire? Yes [] No []

For what purpose? _____

_____

_____

When examining a complex system (e.g. platforms, command & control or weapon systems etc.) there is a trend to downselect technologies early and assess tenders on capabilities of tenderers to deliver? Did you follow this trend? Yes [] No []

For what purpose? _____

_____

_____

What proportion of effort is spent assessing hard and soft issues? Hard _____%
Soft _____%

Marking Schemes

What functional areas were included in producing the weightings?

Team Leader [] Commercial [] Financial [] Requirements [] Technical [] Support [] Industry []

How are the final weightings decided upon?

Team Consensus [] Team Leader Decision [] Tender Leader Decision [] Other _____

When deciding the final weightings bias was accounted for

Strongly Agree [] Agree [] Neutral [] Disagree [] Strongly Disagree [] Don't Know []

Did the weightings allocated utilise the priority schemes for capability identified in the requirements documentation? Yes [] No []

Weightings should reflect priority of requirements coupled with difficulty to achieve

Strongly Agree [] Agree [] Neutral [] Disagree [] Strongly Disagree [] Don't Know []

Did you only accept compliant bids? Yes [] No [] Don't Know []

If no at what level would a bid be rejected? (Number of) Minor non-compliances _____
Major non-compliances _____
Other_____

Were non-compliant alternatives bids considered? Yes [] No [] Don't Know []

Auditing

An audit trial should be maintained for deciding on the tender process to be undertaken

Strongly Agree [] Agree [] Neutral [] Disagree [] Strongly Disagree [] Don't Know []

How did you maintain an audit path throughout the tender assessment? _____

_____

_____

_____

Did all staff assess all tenders? Yes [] No []

Were there any staff changes during the tendering process?

Staff departure towards beginning of process [] Staff departure towards end of process []
Staff arrival towards beginning of process [] Staff arrival towards end of process []

Decision Making

NOTE: When completing this section please be aware of the requirement to solely assess value as opposed to the inclusion of the monetary value.

When performing a tender assessment what priority level do you place on value in the decision-making role, in relation to using monetary value in decision making?

Higher [] Same [] Lower []

How did the best value selection relate to the commercial / cost selection?

Same Solution [] Similar Solution to Selected Cost [] No Relation [] Don't Know []

Was the best value selection the solution chosen? Yes [] No [] Don't Know []

What priority is placed on the level of risk in a project and how is this utilised in the decision making process? High [] Medium [] Low [] Don't Know []

_____

_____

_____

Did you undertake a red team review on the decision? Yes [] No [] Don't Know []

A red team review would add value to the decision making process

Strongly Agree [] Agree [] Neutral [] Disagree [] Strongly Disagree [] Don't Know []

Profile (for statistical purposes only)

Age: Under 30 [] 30 to 40 [] 40 to 50 [] 50 to 60 [] Over 60 []

Employing Branch: Service [] Civilian []

Grade/Rank: _____

Time in IPT: Up to 6 mths [] 6 to 12 mths [] 12 to 18 mths []
18 to 24 mths [] 24 to 30 mths [] Over 30 mths []

Functional Area: Team Leader [] Commercial [] Financial [] Requirements []
Technical [] Support [] Industry []

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